This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

FARMING ON FACTORY LINES

CONTINUOUS CROPPING FOR THE LARGE FARMER

T. WIBBERLEY, N.D.A., N.D.D.

LIME

THE NECESSARY ALLY OF HUMOGEN.

A specially fine powdered Carbonate produced under the Trade Name

CALBUX

is produced by this

TIME

Judge of the Final Court of Appeal.

No further argument, no quibble nor any hesitation. Time gives his Judgment, and his Law holds good.

THE LIBRARY
OF
THE UNIVERSITY
OF CALIFORNIA

PRESENTED BY
PROF. CHARLES A. KOFOID AND
MRS. PRUDENCE W. KOFOID

FARMING IS A BUSINESS

THEREFORE

USE BUSINESS METHODS

AND LAY OUT CAPITAL IN FERTILIZERS TO SECURE LARGE & PROFITABLE CROPS

NITRATE OF SODA

IS A

PROVED MONEY-MAKER

AS IT PRODUCES A HEAVY YIELD PARTICULARLY OF FORAGE CROPS.

Send for pamphlets entitled :—

Practical Handbook on the Use of Nitrate of Soda.
The Improvement of Pastures and Meadows
Catch Crops : The Farmers' Standby.
Economical Fertilizers for the Garden.

They are supplied gratis and post free by

The Chilean Nitrate Committee,
Friars House, New Broad Street, London, E.C. 2.

Farming on Factory Lines

Continuous Cropping for the Large Farmer

By the Same Author.

Continuous Cropping

And Tillage Dairy Farming for Small Farmers, Etc.

2nd Edition. Crown 8vo. Cloth. Price 2/6 net; post free 2/10.

War-Time Farming

Price 6d. net; post free 7d.

C. ARTHUR PEARSON, LTD.

Farming on Factory Lines:

Continuous Cropping for the Large Farmer

By

T. Wibberley, N.D.A., N.D.D.

(of Queen's University, Belfast)

With Eight Full-Page and other Illustrations

London

C. Arthur Pearson Ltd.

1917

If You require a

SHARLOCK POTATO SPRAYER

For Use Next Year

ORDER NOW.

Write for catalogue "C"

TO

MACKIES LTD., READING.

Tel. : 86.

Telegraphic Address :
"*Machinery.*"

S573
W5

DEDICATION

AFFECTIONATELY DEDICATED TO MY
WORKMATE AND MY SOULMATE

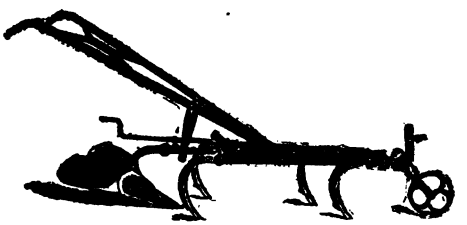
MY WIFE

WITHOUT WHOSE DEAR HELP THIS
BOOK WOULD NEVER HAVE BEEN
: : WRITTEN. : :

M363113

HUNTER'S

Agricultural Implements.



HUNTER HOE.

Also Makers of

Drill Cultivators,
Saddle Drill Harrows,
Spring-tooth Harrows,
Land Rollers, Cambridge Rollers, and Drill Rollers,
Turnip and Mangold Seed Drills,
Scarifiers, Food Coolers and Fodder Barrows,
Adjustable Weeders and Farm Carts, etc.

Speciality—**Artificial Manure Distributors.**

Illustrated lists and prices on application to—

THOMAS HUNTER & SONS,

(MAYBOLE). LTD., MAYBOLE, AYRSHIRE.

CONTENTS

CHAP.		PAGE
I.	CONTINUOUS CROPPING: DOES IT PAY?	15
II.	WHAT FARMERS HAVE TO REALISE	38
III.	FARM *v.* FACTORY: THE RURAL EXODUS	46
IV.	HOW TO CONQUER THE CLIMATE	54
V.	UNSOUND SYSTEMS OF TILLAGE	65
VI.	A REVOLUTION IN CORN-GROWING	76
VII.	EXTENDING THE HARVEST	89
VIII.	THE GROWING OF TARES	95
IX.	SEEDING DOWN WITH A TARE CROP	105
X.	MAKING VETCH HAY	115
XI.	THE SOILING OF TARES	130
XII.	WINTER GREENS AS A SUBSTITUTE FOR ROOTS	135
XIII.	HOW TO CULTIVATE WINTER GREENS	144
XIV.	WINTER GREEN ENSILAGE	156
XV.	GROWING ROOTS AND POTATOES	165

CONTENTS

CHAP.		PAGE
XVI.	THE INTER-CROPPING OF CONTINUOUS CROPS	175
XVII.	CONTINUOUS CROPPING ROTATIONS	188
XVIII.	ROTATIONS TO PRODUCE ANIMAL AND HUMAN FOOD	206
XIX.	SCIENCE AND PRACTICE OF FEEDING	219
XX.	THE WIBBERLEY FEEDING STANDARD FOR MILK PRODUCTION	233
XXI.	HOW PRACTICE SUPPORTS THEORY—A RECORD IN CHEAP MILK PRODUCTION	240
XXII.	CHEAP BEEF PRODUCTION	245
XXIII.	CONSUMING THE CROPS : MORE FACTORY METHODS	252

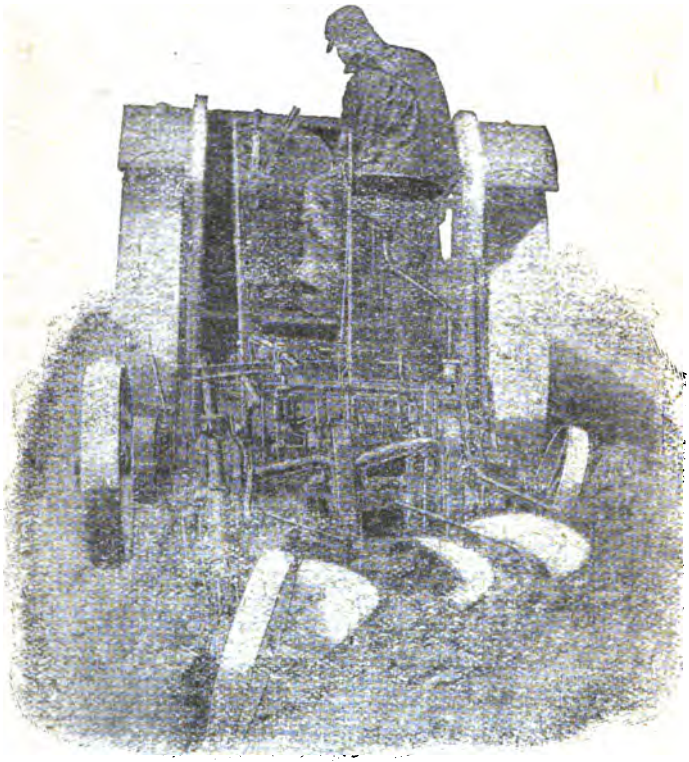
LIST OF PLATES

		PAGE
A Second Crop of Mixed Vetches and Oats	TO FACE	97
Spring Ploughing a Rape Stubble	,, ,,	102
The Third Crop in the Year	,, ,,	108
A Sweet Silage Stack	,, ,,	125
Cattle Fed on a Soiling Crop	,, ,,	131
Soiling Bullocks	,, ,	145
Field of Marrow Stem Kale Mixed with Giant Rape	,, ,,	147
Three Potato Drills at a Time	,, ,,	207

CLYDESDALE

Agricultural Tractors

do all the work of the Farm.



R. MARTENS & CO., Ltd.,

CLYDESDALE HOUSE,

15a WILTON ST., GROSVENOR PLACE S.W. 1.

FARMING ON FACTORY LINES

CHAPTER I

CONTINUOUS CROPPING: DOES IT PAY?

INTRODUCTORY

SOME time, when I have a little leisure, I hope to write a full record of my experiences in devising my system of Continuous Cropping, or Farming on Factory Lines. For the time being it may interest the general reader to learn that my initial inspirations were received from two people, viz., Prince Kropotkin, through reading his famous book, "Fields, Factories, and Workshops," and my father, who was himself a farmer and the descendant of a long line of farmers, and an agricultural economist—without knowing it.

My father once said to me, the while indicating with a wave of the hand, the numerous factory chimneys and colliery head gears, which in his time had sprung up round our home farm:—"Laddie, those are the things which you are up against. I have made money farming, but unless you improve on my methods, unless you can successfully compete with the factory and collieries, you won't."

WHAT THEY DID NOT REALISE

His statement set me thinking, and we had many discussions on the matter. Had I followed my father's general advice I should have adopted some profession other than agriculture, but although at the

time (the " nineties ") the outlook of agriculture was certainly very dismal, every fibre of my being revolted against the idea of leaving the land. Briefly, I decided to equip myself with an agricultural education. I entered a college for this purpose, applying myself vigorously to my studies, and after four years' work I realised why, by tacit consent, agriculturists are classified as " scientific " or " practical."

I learned much about agricultural science—the practical knowledge I had already before I entered the college—but the chief truth I acquired was that the agricultural scientists, with a few rare exceptions, had not sufficient practical knowledge to realise the importance of their own scientific teachings!!

SCIENCE AND PRACTICE

On the other hand, to the practical farmer, science, in any shape or form, was a closed book—something to be ridiculed. To him the exponents of science were " book and blackboard farmers," men who, under the most favourable circumstances, could not make a farm pay. I also learned, that, neither the scientist nor the practical man had even touched the fringe of agricultural economics, or attempted to apply business methods to our greatest industry.

Is it not extraordinary to realise, as the inimitable author of " the Chronicles of a Clay Farm " puts it, that we " are only just beginning to recognise the last of human sciences in the first of human arts "?

It would not be, in any way, difficult for anyone familiar with agriculture in these countries to give extensive illustrations of the truth of the old chronicler's dictum. After completing my college studies I, at all events, decided to make an attempt

to bridge over the gulf which exists between agricultural science and agricultural practice. My efforts in this direction have resulted in the evolution of the Continuous Cropping system. Let the reader keep this well in mind.

Invariably, when lecturing before bodies of *practical* farmers, my work has been referred to as being extremely practical and, myself, as a very practical man. On the other hand, I, at various times, have been referred to by several high agricultural scientists as one who has made valuable contributions to agricultural science and discovered a new system of land management. The latter description is only partly true. The writer's contribution to agricultural science (except in regard to a certain amount of work in connection with the acclimatisation and hybridisation of certain forage crops, and some research work regarding the manuring and cultivation of such crops) largely consists, not in having made new scientific discoveries, but in applying old discoveries in a practical manner.

PSYCHOLOGY OF CONTINUOUS CROPPING

The reader, later in the book, will meet many instances of this, but for the time being, it is necessary, even though the statement involves repetition, to mention that Continuous Cropping might be described as a practical application to agriculture of such sciences as meteorology, chemistry, physics, and economics. In addition, strange as it undoubtedly at the first blush may appear, there is a very close connection between the science of psychology and Continuous Cropping.

Josh Billings describes psychology as " looking into the mind to see what its little game is." Ask any

farmer who has, during recent years, given up tillage in favour of pastoral farming—they are numerous enough—when and under what conditions he determined to make the change. Invariably the answer will be to the effect that it occurred at a time like the spring of the present year, when, owing to bad weather conditions, he and his men and horses were passing through a period of enforced idleness, or when, worse still, after a good year, bad harvest weather had resulted in the partial or entire destruction of bountiful crops.

It is not the dull-minded phlegmatic farmer who is the first to decide on a change during what, in the descriptive language of the Irish farmer, are known as "heart-scalding times." It is the highly-strung man, the man of enterprise, of brains, of energy, who chafes most, and whose temperament can least stand expensive idle times or the financial loss of a destroyed harvest. Too often, with such a man, the change has been from tillage farming, with its many mind-occupying variations, to grass farming, with its dull, weary monotony, which a person of even average temperament finds too irksome, with the result that sooner or later farming is finally forsaken.

THE SURVIVAL OF THE UNFIT

It is well for those who are now chafing over our decadent agriculture to keep these things in mind, and to realise that our past agricultural policy has been of such a nature as to result in the survival of the unfit. They, who until recently never gave the subject of agriculture a second thought, may bemoan our depleted agricultural life, and lament over the tendency of agriculturists "to stick in the mud," but these things are not matters of such great wonder-

ment as the fact that there is anybody left on the land at all, or that there are still farmers willing to incur the risk of any innovation.

The Continuous Cropping system does not entirely eliminate the element of risk from farming—such a thing in agriculture might well be described as impossible—but it greatly reduces the risk. It does away, to a large extent, with idle periods. It gives a man more scope for the application of brains and energy. It opens up possibilities of making agriculture what it should be—an industry in which the brainiest of our population might well find room for the exercise of their mental activities. It makes farming interesting and enjoyable, and to do that is to make it profitable.

THE COMMERCIAL TEST

Do not, however, let the reader imagine there is anything in the system of the nature of an easily applied panacea. Many have made that mistake, and have found later that while the rewards, mental and financial, of Continuous Cropping are high, the acquirement of the necessary knowledge—as is the case with all knowledge—is by no means easy, and can only be acquired by close study and practical experience.

One of the main reasons why practical men look askance, or to be more literally correct, view with supreme contempt, any recommendation of a scientific tinge, is because of the number of improvement schemes which have been placed before them by well-meaning enthusiasts, who have not themselves tested their schemes in a practical manner. Unfortunately, in some instances, these schemes have been launched as scientific discoveries of great importance, and later,

through the schemes proving failures, farmers' minds have been prejudiced against all schemes.

For this reason, although the writer has now been carrying out his investigations for a long number of years, the publication of a book dealing *fully* with the subject of Continuous Cropping has been deferred until the present, when, largely owing to the good offices of Sir Horace Plunkett, it is possible to place before the public facts and figures proving the utility and profitableness of Continuous Cropping beyond all reasonable doubt.

The subjoined balance-sheet and accounts relate to an Irish farm, upon which, a few years ago, at the instigation of Sir Horace Plunkett, it was decided to test the value of the writer's system in a commercial manner; the only test worthy of the slightest consideration. Convincing as the results undoubtedly are, the reader will at once advance the argument that an isolated experiment only proves the need for more experiments. In other words, the success of a system on any one farm cannot be regarded as a criterion of success elsewhere.

SUDDEN INCREASE IN PRICES

This is undoubtedly true, and for this reason, it is necessary to make the statement that the writer has by no means based his recommendations on the results obtained from one farm. Simultaneously with the commencement of the experiment on the particular farm under review, the Continuous Cropping method of farming was started on several other farms distributed over a very wide area. Unfortunately, in several of the latter cases, the sudden increase in prices has resulted in profits being made which are not in the least attributable to the system of Continuous Cropping.

In one case, for example, the owner was recalled to his military duties, and, being unable to obtain the services of an efficient manager, the original plan of Cropping and accounts-keeping had to be abandoned, just prior to the time when most conclusive proof over a series of years of the greater profits from Continuous Cropping would have been forthcoming.

It might also be mentioned that, apart from the farms referred to above, a very large number of farmers in these countries, prior to the commencement of these experiments, had adopted in part, or in whole, the Continuous Cropping method of tillage, and although as is usual with farmers in general, no definite accounts were kept, they invariably, year by year, have extended the system.

Particularly is this the case in County Limerick, where for six years I was employed as County Instructor under the Irish Department of Agriculture, and in which county the original investigations of the system were commenced. Here, perhaps I may be pardoned for mentioning (but my main object is to place before farmers generally facts showing how farmers who have adopted my system have valued it), that when I resigned my position in County Limerick the farmers presented me with a purse of sovereigns and an illuminated address referring, in most glowing terms, to the utility of the Continuous Cropping system. This address will ever be my most cherished possession.

CONDITIONS OF THE EXPERIMENT

The main reason why it was decided to carry out experiments on the farm, to which the subjoined accounts refer, was because the land is what is

known in Ireland as good grazing or bullock-feeding land. Prior to the application of the Continuous Cropping system, the land had been devoted entirely to the grazing of bullocks and a few sheep, the bullocks being bought-in in store condition and sold off, fat.

Many attempts to cultivate similar land in Ireland had previously been made, but in every case, the tillage had proved a disastrous failure. This, in the writer's opinion, was due to the fact that the system of tillage (generally a modification of the Norfolk four-course rotation) was entirely unsuited to the soil, climate, and labour conditions which obtained.

MAN *v.* BULLOCKS

Everybody concerned, except Sir Horace Plunkett and myself, were strongly of the opinion that no system of tillage could be made pay as well as grazing on such land. In this latter statement we have an illustration as to the low level to which our agricultural outlook has sunk. The same idea is prevalent in every good grazing land district in these countries, and, in principle, means nothing more nor less than that a grazing beast is a more productive and a more economic unit than a human being!! In other words, the experiment may be regarded as a comparative or economic test between human beings and the beasts of the field!

When land is merely grazed, the reduction in fertility is very small, and, for this reason, one of the conditions of the experiment was that practically all the food grown on the farm should be fed to animals, or, in farmers' language, "the crops should walk to market." A slight exception to this rule was made to the extent that it would be permissible

to sell off sufficient potatoes to cover the labour bill, but, as a *quid pro quô*, in making up the valuation at the end of the year, no allowance could be made for the unexhausted value resulting from the purchased food consumed on the farm, or the application of lime, slag, or other fertilisers. This latter condition has been strictly adhered to.

Another feature which it is very important to mention is that the writer had not the entire control of the farm, most of the stock being purchased and sold by another person. In theory, it was assumed that the writer should be consulted as to the purchasing and selling of the stock, but, in practice, for one reason or another, his advice was seldom followed. The practical farmer will at once realise what a tremendous handicap this latter condition was. Dual ownership of land may or may not be a poor arrangement, but dual management of land is wretched.

There were also other hampering conditions. The farm was part and parcel of a gentleman's demesne, and an attempt was made to dovetail the work of the farm with that of the demesne. As, in practice, the carrying out of important estate work clashed with important agricultural operations, this arrangement proved to be very bad. Further, the whole work was carried out by men who had had no previous experience of tillage operations, and to whom the whole work was nothing short of a revolution.

It is particularly desirable to emphasise this latter fact since, leaving figures entirely out of the question, the experiment has proved to the satisfaction of even the most captious critics (and what a number we have in Ireland!) that Irish labour, *given a proper chance and a proper wage*, can be just as efficient in Ireland as anywhere else in the world.

In the first year many mistakes, which to an experienced tillage farmer would be regarded as examples of colossal stupidity, were made, but before the second year had passed, a very fine standard of labour efficiency had been obtained. Not to labour this question further, the writer simply wishes to add that he has had great experience in the management of farm labourers, including Irish labour, in England and elsewhere. Only in Ireland is the efficiency of Irish labour ever questioned. Yet he has no hesitation in saying that the labour on the farm referred to, as well as that on several other Irish farms, has proved itself to be, when given a suitable reward, together with the necessary leadership, quite as competent as English, Irish, Scottish, or any other type of labour he has ever employed or supervised outside of Ireland.

INEFFICIENCY AMONG LABOURERS

In Ireland we labour under many delusions, not the least of which is, that in Ireland an Irishman, of necessity, must be incompetent. A closing word to farmers in general on this question. Inefficiency among farm labourers, in nine cases out of ten is either due to one, or other, or both of the following causes—low wages with a low standard of comfort or inefficiency on the part of the farmer himself.

Be efficient yourself, Mr. Farmer. Get the labourers into the habit of thinking that you yourself are the most efficient workman on the place. Let them understand that, when you are giving orders, you are speaking with a mind formed and informed. Above all, do not treat your labourers as inferiors. Realise that the mud-stained peasant of the field is the most important human factor in all countries and in all ages!

That condition which necessitated the consumption of crops on the land, chiefly by store bullocks, proved to be of the greatest importance, since the profits obtained are directly attributable to the Continuous Cropping system of tillage, and not to enhanced prices.

NOT WAR-TIME FARMING PROFITS!

As will be seen from the accounts, the main source of revenue has been from the sale of live stock, which, in all cases, was finished beef or mutton. Now, the point which it is most desirable to emphasise is that the margin of difference between the cost of a store bullock per live cwt. and the selling price of the bullock as beef per live cwt. has not been greater in consequence of the war than it was in pre-war times. In fact, during the year to which the sub-joined accounts refer, this margin has been less than was the case in pre-war times.

From very carefully-kept records it can be demonstrated that with about 90%* of the cattle purchased, taking the live cwt. prices of the store cattle as delivered on the farm, with auction fees and other expenses added, and comparing those prices with the prices per live cwt. obtained for the finished beef, the margin of difference would not exceed 1/6 per live cwt.!! Of course, there have been bunches of animals bought in, say in October, and sold in the following May or June, where the margin referred to has been as much as 10/- to 15/- per live cwt., but in order to keep up supplies, as one lot of finished animals went out, another lot of store cattle were bought in, and often indeed, the price per live cwt.

*About 10 per cent. of the cattle were neither weighed on arrival at the farm, nor when sold.

of the bought-in stores has exceeded the price obtained per live cwt. of the beef.

This matter could undoubtedly have been arranged differently by simply making no attempt to turn out beef during the winter, and by using all the food during winter for the feeding of a sufficient number of store cattle to stock the land during summer, planning in addition to sell largely in mid-summer and at other times when beef reaches high prices.

PRICES OF STORE BULLOCKS

For the information of the reader not familiar with the fluctuations in the prices of cattle, which fluctuations are fairly constant, it may be necessary to point out that store bullocks are always relatively and absolutely far cheaper from November to, say, the end of January, than from February onwards when on this particular farm every year a large proportion of bullocks were bought in, despite the writer's adverse advice.

On the question of the rent charged, one feature is worthy of mention. The area involved varied from year to year. Taking the Irish acre to represent 1.5 statute acres; the portion of the estate devoted to the experiment in 1913-14, was 298 acres; in 1914-15, 327 acres; and in 1915-16, 360 acres. These variations in the size of the farm introduced several complications. Any land which at the annual grazing auction did not bring £3 per Irish acre came into the scheme, and, in one or two instances, pasture land originally in the scheme, for which at the end of the year a higher grazing rent than the above was offered, was dropped out of the scheme.

This meant, in practice, that the fields included in the experiment were not within a ring fence by any

means. Often indeed it happened that between one field tilled and another there would be one or two fields let to outside tenants for grazing, and only at certain times of the year was it permissible to cross such fields with a cart. Also, this arrangement necessitated the cultivation of fields to which for other reasons than those given above access was difficult.

RENT AND WAGES

Let me refer again to the subject of rent. It may be mentioned that those responsible for the scheme expressed the opinion that they would consider the experiment a financial success if it were proved by the system of farming followed, the rent of £3 per Irish acre could be paid, as well as interest at bank rate on the capital invested, and dead stock depreciated at the rate of 10% per annum. Not only has this been done, but the profits for over a three years' period amounted to on an average, slightly over the sum of £582 per annum.

It should also be pointed out that, under the grazing system, the amount paid in wages was extremely small. As a rule in the district, a herd and an assistant, with casual labour for the repairing of fences and ditches, are employed to about every 1,000 acres of grazing, whereas under the tillage system which was carried out, the labour in the first year of the experiment was £293 7s. 9d., in the second year £505 18s. 7d., and in the third year £496 5s. 5d. A bonus to the workmen was also paid annually, and the wages otherwise increased very considerably over the rate paid when the grass-fed bullock held sway.

Another matter worthy of attention is that the

management expenses, chiefly consisting of the writer's fees and expenses, have been about £130 per annum. In the case of an ordinary farmer managing his own farm, this would be regarded as additional profit.

PURCHASE OF FEEDING STUFFS

Later in the book, special attention is drawn to the fact that, by the adoption of the Continuous Cropping system, the necessity for the purchase of cakes and meals of an albuminous character, and generally of a foreign origin, can be dispensed with. On this point, when the first year's balance-sheet was published by Sir Horace Plunkett, a tremendous amount of adverse criticism arose. It appeared to the critics that the writer was condemning the purchase of such feeding stuffs, and yet, on this and other farms, he himself was purchasing a large amount of such feeding stuffs. These particular critics, as the practical man will easily understand, were not themselves practical farmers.

The farm was handed over to the writer's management in November, 1913. At the time, there was a considerable amount of hay belonging to the estate, which had been allowed to accumulate. This hay, shortly after the experiment had been commenced, was put up for auction, and brought what the owner and the writer considered a very unsatisfactory bid. For this reason it was bought in for use on the farm. Properly speaking, it should have gone into the valuation. In addition, a considerable amount of various kinds of cakes were purchased in the first year, as, of necessity, one could not delay the purchase of all the live stock until such times as the

continuous crops were available, or the portion left in pasture was ready for grazing.

Again, in the second year, purchased feeding stuffs to the extent of £614 8s. 4d. were bought, but of this £157 12s. 2d. worth was fed to pleasure horses kept by the owner of the farm, and to dairy cows kept for the supply of milk to the household, thus leaving £456 16s. 2d. spent in feeding stuffs for the use of the farm. This latter figure also includes the value of some of the hay referred to above, which was charged against the farm as it was used, and the balance represents expenditure on feeding stuffs, cakes, meals, etc.

ALBUMINOUS FOOD

The purchase of these feeding stuffs was necessary, even in the second year of the experiment, because a *sufficiency of albuminous foods was not available* for using with other foods on the farm, when balanced rations were fed. For example, in the spring of the second year, we had about 12 statute acres of "winter greens." These were folded off with bullocks and sheep. The supply of vetch hay was by this time exhausted, and, as will be easily understood, it was necessary to feed the succulent forage along with an astringent food—in this case undecorticated cotton cake.

Some critics have asked the question why was not more dry albuminous food—vetch hay—grown in the second year. The explanation is quite simple—redundant in the case of the practical man. One cannot step into a rotation of crops in one year, especially under the circumstances referred to, when all the land was previously grass land untilled for

perhaps forty years. It is only on paper these things can be done.

In the third year of the experiment, however, a sufficiency of albuminous food had been grown to balance the non-albuminous, and an expenditure on feeding stuffs for cattle and sheep of only £81 2s. 2d. was necessary. The sales of this kind of stock amounted to the sum of £5,188 14s. 7d., which represents about 7s. 6d. for every fat bullock sold. Had it not been that the bullocks were chiefly sold for export to England, and in consequence, in order to " tighten them " had to be fed on astringent food before railing, even this expenditure could have been dispensed with. Since the accounts were made up, it has actually been dispensed with, for in the first three months of the current year, ending February 28th, 1917, the value of the fat cattle sold is £1,490 10s. 6d., whilst the purchase of cattle feeding stuffs is nil.

COST OF PIG FOODS

The expenditure on pig foods, small as it may appear, is, in the writer's opinion, too high, being, as may be seen from the accounts, £80 18s. 6d. for the £218 16s. 10d. worth of pork sold in the year 1915-16. For reasons, which need not be entered into here, it was not possible for the writer, on this particular farm, to carry out his folding system of feeding pigs, which he so strongly recommends.

Just as it is possible, as the system of Continuous Cropping develops, to reduce the expenditure on feeding stuffs, so is it possible to make a similar reduction in the expenditure on manures and seeds.

As is mentioned later, it is very necessary to be liberal in the use of artificial manures, when the

Continuous Cropping system is first adopted. Later, as the stock-carrying capacity of the land is increased, and as the amount of farm manure is increased, and a large supply of nitrogen is so added to the soil by the growing of leguminous crops, expenditure in the direction of manures can be considerably reduced, as the following table shows:—

Year.	Artificial Manures and Lime.	Seeds.	Total.
1913—14	£83 0 5	£196 14 11	£279 15 4
1914—15	76 14 6	77 5 2	153 19 8
1915—16	2 11 9	64 13 4	67 5 1

As the table also shows, a similar economy can be effected to a certain extent by the farmer growing his own seed.

Considering the area cropped, the expenditure on artificial manure and lime has not, in this case, been very great. This is due to two reasons:—first, the land, as has been mentioned, was fairly fertile, and secondly, a large expenditure in the first and second years of the experiment was incurred for feeding stuffs which resulted in our having a considerable amount of farmyard manure available. With the wisdom gathered from experience, the writer, were he undertaking a similar experiment, would adopt the course of more liberal manuring with artificial manures and consume the crops on the land, rather than purchase feeding stuffs, when the main object is the procuring of an adequate supply of manure.

Anyone with even an elementary knowledge of account-keeping will realise that the profits or losses on a farm in any particular year will vary according to the values placed on the various assets at the close of the year. For this reason it is necessary to say a few words as to the basis on which the valuations have been made. As regards live stock, in the first year of the experiment these were valued by an independent farmer of great experience—a relation of the owner's—and the writer. The system adopted was to assume that the bullocks—of which the live stock consisted—had increased in value at the rate of 14/- per month from the date of purchase to the date on which the valuation was made. Subsequent sales —due to a fall in prices—proved that the live stock valuation had been made too high, so that in the following half-year the cash profits were about £100 less than the " paper profits."

VALUATION OF LIVE STOCK

In the second year the valuation of live stock was made by the cattle salesman who was entrusted with the stocking of the farm and the sale of live stock when finished. He at the time of the valuation, anticipating a slump, valued the cattle at from 30/- to 40/- per head less than they had actually cost two or three months previously at his own auction. No slump occurred, and, in consequence, at the end of the half-year, by which time the bullocks on hand when the valuation was made had been turned into cash, the cash profits were approximately £300 higher than the " paper profits."

At the close of the third year most of the bullocks had been on hand two or three months, and were put into the valuation at cost price on the date of

purchase. Subsequent sales prove, as one expected, this valuation also to have been lower than it should have been. As to other stock, sheep and pigs, these throughout have been valued at prevailing market prices when the valuations were made. As to produce, this, with the exception of potatoes, was valued at consumptive value rates.

Here are the

FARM ACCOUNTS.

1st December, 1915,

to

30th November, 1916.

Of a 360 statute acre farm. Managed and cropped on the "Continuous Cropping System"

by

The Author.

Accounts audited by

Albert Swain (Auditor), Dublin.

Re-cast and re-arranged by

John Green, Chartered Accountant (Bursar of The Queen's University of Belfast).

WORKING ACCOUNTS.

LIVE STOCK.

Dec., 1915	£	s.	d.	Nov., 1916	£	s.	d.
1 Valuation of Stock ..	2,886	9	0	30 Sales :—			
Nov., 1916				Fat Cattle	4,776	3	7
30 Purchases ..	3,808	7	5	Sheep ..	412	11	0
30 Feeding Stuffs	173	11	5	Pigs ..	218	16	10
30 Revenue Account					£5,407	11	5
Profit ..	1,939	12	7	30 Valuation of Stock ..	3,400	9	0
	£8,808	0	5		£8,808	0	5

PRODUCE.

Dec., 1915	£	s.	d.	Nov., 1916	£	s.	d.
1 Valuation of Stock ..	1,527	5	6	30 Sales ..	319	5	2
Nov., 1916				30 Milk and Supplies to House ..	126	8	2
30 Purchases— Seeds ..	67	5	1	30 Valuation of Stock ..	1,916	12	6
30 Manures (Nil)							
30 Revenue Account							
Profit ..	767	15	3				
	£2,362	5	10		£2,362	5	10

FEEDING STUFFS.

	£	s.	d.		£	s.	d.
Nov., 1916 ..				Nov., 1916			
30 Purchases—				30 Horse Feed—			
Cake for Cattle	81	2	2	Pleasure Horses ..	61	3	0
Meal for Pigs ..	80	18	6	30 Feeding Stuffs used by Live Stock ..	173	11	5
Bran, Oats and Hay for Horses	91	17	9	30 Feeding Stuffs on hand ..	19	4	0
	£253	18	5		£253	18	5

IMPLEMENTS.

	£	s.	d.		£	s.	d.
Dec., 1916				Nov., 1916			
1 Valuation ..	221	14	0	30 Revenue Account — Depreciation at 10 per cent. per annum	23	8	10
Purchases ..	12	16	6	30 Valuation	211	1	8
	£234	10	6		£234	10	6

REVENUE ACCOUNT.

	£	s.	d.		£	s.	d.
Labour ..	496	5	5	Live Stock —			
Freight, Harness Repairs, Shoeing and Smithwork, Petrol Oil, Veterinary Fees, Straw, Stationery and Sundries	204	1	6	Profit ..	1,939	12	7
				Produce—Profit	767	15	3
					£2,707	7	10
				Horse Labour	35	5	0
Implements — Depreciation	23	8	10				
Balance carried down ..	2,018	17	1				
	£2,742	12	10		£2,742	12	10
*Rent (240 Irish Acres at £3)	720	0	0	Balance brought down ..	2,018	17	1
Interest on advances ..	140	2	0				
Balance carried down, being Net Profit for year ..	1,158	15	1				
	£2,018	17	1		£2,018	17	1
Deduct Management Salaries	165	4	9	Balance brought down ..	1,158	15	1
Balance carried to Balance Sheet ..	993	10	4				
	£1,158	15	1		£1,158	15	1

* An Irish acre is approximately 1½ Statute acres.

BALANCE SHEET.
30TH NOVEMBER, 1916.

LIABILITIES.	£	s.	d.	£	s.	d.
BANK OVERDRAFT ..	1,856	3	7			
CATTLE SALESMAN'S ADVANCE ..	1,237	16	9			
				3,094	0	4
CAPITAL ACCOUNT:						
Advance by Owner ..				1,575	11	3
TOTAL ..				£4,669	11	7
PROFIT AND LOSS ACCOUNT:						
Net Profit per Account	993	10	4			
Deduct Bonuses and Gratuities to Workmen	86	19	0			
				906	11	4
Leaving clear profit after paying bonuses etc.				£5,576	2	11

ASSETS.	£	s.	d.	£	s.	d.
STOCKS:—						
Live Stock	3,400	9	0			
Produce	1,916	12	6			
Feeding Stuffs ..	19	4	0			
Implements	211	1	8			
				5,547	7	2
ESTATE ACCOUNT:—						
Amount due per previous Balance Sheet ..				28	15	9
				£5,576	2	11

Average Annual Profit for 3 years:—1914, 1915, 1916 ... £582 3 8

CHAPTER II

WHAT FARMERS HAVE TO REALISE

BEFORE proceeding to describe the system or the advantages of Continuous Cropping it may not be out of place here to make a general survey of the present agricultural position, and, incidentally, to attempt a defence of the farmer, whom well-intentioned, but ill-informed, people seem bent on vilifying at the present time.

Many columns of the Press at the time of the writing of this book are being devoted to the question of food production. From all sides demands are being poured out for an immediate increase in the supplies of home-grown food or, in other words, for an increase in our arable area. The line of demarcation between tragedy and comedy is never very well defined, but to anyone like the writer, who for years has been preaching and (will some of the reviewers of my previous books please note?) also practising a revival of arable farming—these outpourings are occasionally, in spite of their tragic cause, almost comic.

Only a few years ago, a daily paper, which claims to be the most influential paper in Ireland, denounced the greater production of food as likely to cause a slump and result in low prices. Indeed, one might, at one time, scan hundreds of columns in the Press, and read nothing of greater agricultural importance than accounts of lambs being born with more than

the usual number of heads or legs, or of a cow, which, "prompted by a desire to do her bit, had given birth to triplets."

FARM LABOUR DEMANDS SKILL

Naturally one's inclination is to let by-gones be by-gones, and to console oneself with the thought that at last Britain has awakened to the fact that there is such a thing in existence as British Agriculture. To forget the past, might, from the farmers' standpoint, appear magnanimous. Nevertheless it would be a serious error. In agriculture, at least, past conditions are, in the absence of a crisis, apt to be identical with conditions of the future. We cannot afford to neglect the lessons of the past. "To cure is the Voice of the Past; to prevent, the Divine Whisper of the Present."

True, we farmers were recently enjoined in numerous pamphlets, lectures, and speeches, largely emanating from those who had been ruling, or rather misruling, the agricultural destinies of these countries, to put more land under the plough. Little heed, however, was paid by practical farmers to these admonitions. The reason was not far to seek. In Great Britain, at that time, we had one Government Department advising farmers to put more land under the plough, and another reducing the supply of available labour so effectively as to prevent them from carrying out all such excellent advice. Attempts were then made to substitute unskilled labour for skilled on the land, but as might have been expected, and as every practical man did expect, those efforts, to say the least of them, gave very unsatisfactory results.

The truth is, the movement to dilute farm labour in this manner was erroneous in conception. It was assumed that labour on the land was unskilled work, which the veriest tyro might be capable of performing with a little training, whereas it is nothing of the sort. There is not, in the whole gamut of human labour, skilled or unskilled, greater dexterity and knowledge required than that possessed by the rural worker.

Take, for instance, the work of a ploughman. True enough, a novice can guide one of the modern wheel-ploughs, once the implement is "set" and the land "opened out," but the skilled man is required for the "setting of the plough," the "opening out," and the finishing of the ridges.

KEEPING IMPLEMENTS IN ORDER

Again, ploughing is, on most farms, only a minor portion of the ploughman's duties. In turn, he must operate, at least, a dozen implements—moulding ploughs, grubbers, cultivators, potato diggers, swathe turners, corn binders, etc. Many of these implements, especially the corn binder, require far more skill than is required for the running and keeping in order of a high grade motor. Not only must a ploughman be able to work the different implements, but he has also to keep them in order and to fix new parts, work which requires a very considerable amount of mechanical skill.

Then look at the work of a herd or stockman. Any novice can prepare and serve out food to cattle, or milk a dairy cow with practice, but it requires the person of experience, and one often thinks hereditary experience amounting to instinct, to

diagnose immediately the reason for a bullock being "off its feed," or to "sense" in the stock—no other word will describe it—impending udder, parturition, and other troubles.

Again, the building of a stack requires as much skill as the building of a house. The same may be said as regards the building of a clamp, or pit, of roots or potatoes, with this difference: it is not so easy to detect faulty work in the clamping as in the erection of the house. Faulty work in the former might easily result in the rotting of the entire clamp, especially potatoes.

UNSKILLED WORK

It may be argued that the attempt to dilute farm labour really aimed at supplying labour for the unskilled work on the farm as supplementary to the skilled. In other words, the unskilled work should have been confined to such occupations as root singling, hoeing, manure carting and spreading, and so on. Even these occupations, however, require skill, and far more skill than even a farmer himself need be aware of, until he sees a man or woman with no previous experience attempt such tasks.

The point, however, which needs emphasis is, in order to use unskilled labour, a far greater proportion of skilled to unskilled labour is necessary in the agricultural than in the manufacturing industries.

LABOUR ON IRISH FARMS

So far I have dealt with the situation as regards Great Britain. Until quite recently (January, 1917)

little has appeared in the British Press, as to the possibility of increasing the food supplies of these countries by a rapid development of Irish Agriculture. Yet the potentiality of Ireland in the direction indicated, was, and is, still greater than in any part of the United Kingdom.

In the first place 85% of the farms in Ireland are not more than 50 statute acres in extent. That is, Ireland is essentially a country of small holdings. Whilst the relative returns which might be obtained from large and small farms is a matter of controversy, the fact remains that, so far at least, the gross revenue per acre of land is greatest in all European countries where small holdings prevail. It is particularly true in regard to Ireland, as shown by the following table:—

STATISTICS OF IRISH SMALL HOLDINGS AND FARMS

Live Stock and Poultry per 100 acres.	Farmers of 30 acres and less.	Farmers of 50 acres and more.	Farmers of 100 acres and more.
Milch cows ..	15	14	6
Other cattle ..	23	23	23
Sheep	19	19	36
Pigs	15	14	3
Poultry	366	295	52

It may be contended that the "other cattle," chiefly young stores, on the smaller farms, are younger and less valuable than those on the larger farms, but against that there is this fact. The nightmare of history through which Ireland has passed has resulted inevitably in the smaller and far more industrious farmer being segregated on the poorer land. The rich land is held by the rich farmer and grazier. The smaller the farm, the greater the

area tilled or meadowed. Thus Irish farmers with 30 acres or less, crop more of their holdings than does the farmer holding 100 acres or more.

MAN-POWER IN IRELAND

Another point of importance is:—the agricultural man-power of Ireland, in proportion to the area cropped, is greater than any other part of the United Kingdom. Thus statistics show that on the 1st of June, 1913, there were in Ireland approximately:—

Male members of farmers' families	492,000
Permanent male labourers	126,500
Casual male labourers	97,000
Female members of farmers' families	178,800
Permanent female labourers	16,000
Casual female labourers	207,000

Thus the whole total actually employed on the land consisted of:—

Males	715,500
Females	401,800
Grand total ..	1,117,300

(In each case the figures refer to people of 18 years of age and over).

In 1913, there were 2,338,749 acres of land in Ireland under the plough, or approximately 26 male workers for every 100 acres of tillage land. Including the area cut for hay (2,481,862) and, therefore, requiring human labour, the total area cropped was 4,814,611 acres, giving approximately 13 male workers for every 100 acres cropped.

The latest available census of agricultural labour for England and Wales shows that prior to 1914 there were, exclusive of female labour and farmers' male relatives under 15 years of age, 1,002,743 males working on the land.

During the year 1913, in these two countries, there were:—11,058,233 acres of ploughed land and 6,770,173 acres cut for hay, thus giving 9 male workers (approximately) for every 100 acres tilled, and 6 male workers to every 100 acres cropped.

A similar and equally striking comparison between the two countries can, I believe, be made between the number of live stock on the land and the number of people engaged in attending to that stock. True, exact figures are apparently not ascertainable as to the number of female farm workers in England and Wales, but I hold that anyone with knowledge of agricultural conditions in the two countries must admit that Ireland has the greater number of workers.

WHERE CONTINUOUS CROPPING PAYS

It may be argued that a fair comparison on the lines stated above is not possible, inasmuch as it is not feasible to obtain the same agricultural output per man in Ireland, as in England and Wales. To that contention the writer, who probably handles more tillage in Ireland than any other farmer, and who in addition is a partner in, and controls an English farm, has no hesitation in making answer. Not only is it possible for the Irish rural worker to equal the present standpoint of his English contemporary, but, *by the application of more progressive methods, the agricultural output in both countries per*

manual worker can be very largely increased. By more progressive methods is meant, farming on factory lines, the use of up-to-date machinery, and a more extensive and intensive system than at present prevails—a system which aims at eliminating so far as possible costly hand labour, and which is far less risky than the prevailing system of land cultivation.

This system is known as Continuous Cropping, the system which I have been advocating for years.

CHAPTER III

FARM *v.* FACTORY: THE RURAL EXODUS

For years throughout the United Kingdom there has been a continual drifting from the country to the town. Many are the solutions which have been put forward to check this rural exodus—the multiplications of small holdings; the brightening of rural life by furnishing more amusements; and the erection of more labourers' cottages. Few people, however, seem to have realised that the main cause for the migration from the country to the town is not the greater attraction (as the word is generally understood) of town life, but the better wage and better conditions of employment which industrial life, as compared with rural life, has to offer.

INDUSTRIAL SUPREMACY

This matter of labour is the root question of our decadent agriculture. There are few farmers who do not realise the truth of the latter statement. There are still fewer who realise in what direction its economic solution lies. Yet the problem must be solved, if we are to supplant our grass-growing prairie farming by tilled fields.

It is not alone to the agricultural labourer and his sons and daughters that the town, or industrial life, has proved more attractive than the countryside. The same attraction has operated as regards the

farmer's own sons and daughters, and in some cases as regards the farmer himself. The men of energy and enterprise have left the plough for the pick, the loom, the lathe, and other industrial tools. In short, since the time when England began to concentrate on her industrial supremacy and concomitantly to neglect her agriculture (meaning by the term industrial, all industrial and manufacturing industries) the farm and the factory have been in direct competition for both brain and labour.

To present the case in another fashion, it should be remembered that the rate of wages on the farms has not been controlled by the wage rate on the adjoining farms, but by the wages paid by the colliery owner, the iron master, the ship builder, and the factory owner. The development of industrial life should have fostered agricultural activity, but, in practice, it has had the opposite effect. Whilst for years we have been complacently paying the foreign farmer approximately £350,000,000 for food for ourselves and even our flocks and herds, our own soil has been allowed to tumble down to grass, to produce the minimum, and to return in fact to its prairie value.

HOW THE FARM SUFFERS

In this contest between the farm and the factory, the former has suffered from the very severe handicap of adverse climatic conditions. In the factory, or other industrial occupation, it does not matter much what weather conditions prevail. It may rain, snow, or hail,—none of these climatic conditions cause one yard less cloth to be manufactured in the mill, one ton less coal to be brought to the pit mouth,

or one rivet less to be put in the building of a ship. In other words, independent of weather, every work-day is an *effective* work-day for the industrial workers.

It is not so on the farm. A shower of rain often prevents the whole staff of men and horses from making progress with farm work, or may result in work already performed having to be repeated. Under our present tillage system, the more land the farmer has under the plough the more he is at the mercy of the elements and the greater are his risks. Conversely, the greater the area a farmer has under pasture the less the risk, "the more," to use the farmers' own language, "he is independent of labour."

It is this frank recognition of the factors of risks and labour dependence that has been responsible in the past for the spread of pastoral farming. These factors operate to-day, and will operate in the future, but unlike pre-war days, we can no longer be content with pastoral farming. The future of our countries from an agricultural, a financial, a national, and a military standpoint, demands the production of more food and more wealth from the soil of our homeland. Even our industrial life demands it, for a large and cheap output of industrial products is not possible when the industrial worker is compelled to pay a high price for the food he consumes.

FARMING ON FACTORY LINES

There is only one way by means of which the farm can successfully compete with the factory, and that is by running the land on factory lines, aiming, as in a factory, for an even distribution of labour

throughout the year, and using wherever possible labour-saving and labour-economising machinery. We must use human brains and human hands to direct and control machinery, rather than to expect our rural work to be carried on, as in the past, under conditions that often meant brawn being more valuable than brains.

THE LABOUR QUESTION SOLVED

There is only one way in which the labour question, or the problem of the rural exodus, can be satisfactorily settled, and that is by the payment of better wages, wages which will compare favourably with those paid in industrial life. To do this, the writer's contention is that it is necessary to run a farm under the same conditions as far as possible as obtain in industrial life.

As a matter of fact, the rate of wages paid for an *effective* day's work on the farm is quite as high as the rate paid in industrial life. For instance, if a farm labourer is only receiving 2/6 per day, his daily wages for *effective* days is really greater than a dock labourer receiving 5/- per day. The explanation is simple. Often for one effective day—a day that it is possible to carry on field operations—there are several days when both men and horses, through stress of weather, are perforce idle, semi-idle, or engaged on what a farmer calls " filling-up " jobs.

Under our present system of tillage (repetition is necessary to emphasise the point), the greater the area under cultivation, the greater the percentage of ineffective working days for the staff, horses as well as men. On a grass-growing farm, except at hay-time,

and on days when it is too wet for fencing, ditching, etc., the percentage of ineffective days is very low, and under such conditions small also is the amount of labour employed. The practical farmer long ago recognised the truth of the foregoing, and he solved the problem by turning his land into a prairie, depending upon the importation of foreign feeding stuffs for the supplementary feeding of his flocks and herds, and, to a large extent, even of himself and his family.

CHEAP POLITICAL NOSTRUMS

Talk to a farmer of these matters, and invariably the only solution he can offer is Tariff Reform, or something to check the importation of foreign goods. Considering that the farmer himself uses such a large amount of foreign food in the manner referred to above, the solution he suggests seems very contradictory. Whatever policy the political gods may have in store for us in the future we may rest assured that there can be no Tariff Reform, no guarantee of prices for home-grown products without a concomitant guaranteed minimum farm wage for the farm labourer, so that eventually the margin of difference between the cost of production and the sale price of farm products may be no greater than it has been in the past.*

The writer owes no allegiance to any political party, and, it must be added, has little faith in any brand of political nostrums, so far as land is concerned, unless it provides for a far greater output *per*

*Since this book was written the "Corn Production Bill," which provides a minimum wage for farm workers, has been passed by Parliament and received the King's assent.

acre of land and more economical production. It is well, also, for farmers to keep in mind the simple truth that the man in the street will rule the man on the land, and in the absence of a crisis, as in the past, will demand cheap food.

NO WEATHER GUARANTEE.

There is just one point, however, that ought to be mentioned in connection with guaranteed prices, and that is, that such prices are concerned with crops only when they are safely garnered. There is no guarantee for suitable weather for the cultivation of the land and the sowing and harvesting of the crops. A guaranteed price of 60/- per quarter for wheat is not of much use to a farmer when his crops are rotten on the ground!

Guaranteed prices, or no guaranteed prices, whether in future a policy of Free Trade, Tariff Reform, or a Bounty System of Agriculture is adopted, there is no doubt that we must adopt a far more intensive system and a less risky one,—a system aiming at a lower cost of production,—in short, a Continuous Cropping system, when once the value of the features of the system have been grasped.

TILLAGE *v.* GRAZING

Just as we, as a nation, have, in many respects, copied the German system in the art of war, it is to be hoped we shall also copy some of the German methods in the greater arts of peace, especially so as regards agriculture. That there is need for such may be gleaned from Mr. Middleton's book on "Recent Development of German Agriculture."*

*Price 4d. Board of Agriculture and Fisheries, 3 St. James Sq., Westminster.

There are many striking comparisons in Mr. Middleton's production, but none more suggestive, or bears so much on the tillage question, as the following compilation, showing the average amount of farm produce obtained from 100 acres of cultivated land, obtained annually in Great Britain and Germany:—

	In Great Britain	In Germany.
100 acres of land	Feeds 45 to 50 people Grows 15 tons of corn ,, 11 tons of potatoes ,, 4 tons of meat ,, 17½ of milk Negligible quantity of sugar	Feeds 70 to 75 people. Grows 33 tons of corn ,, 55 tons of potatoes ,, 4½ tons of meat ,, 28 of milk ,, 2¾ of sugar

The cause of the greater production from the German soil is not far to seek. The German farmer had approximately two-thirds of his land under the plough. In Great Britain we had less than one-third, and in Ireland approximately one-eighth. No one need therefore be surprised to learn that, with the greater proportion of arable land, the German farmer should produce more grain and potatoes than the British farmer, but many experts were certainly greatly surprised to learn that the German also produced more milk and meat.

They may also be surprised to learn that in the last ten years the Continuous Cropping system has made tremendous strides in Germany. Long before the authorities in these countries heard of my work, leading German experts had visited me and investigated its merits. Again, whilst my British pupils generally had taken up the study of agriculture on the recommendation of the family doctor—because they had

either a decimal of a lung or a brain—my German students were always highly qualified men.

We have long boasted of our superiority as live stock farmers, and from the standpoint of quality justly so, but we have overlooked the elementary fact that for stock-raising and stock-feeding, an acre of tilled land produces double and treble the amount of food that can be produced from an acre of similar land in grass. The truth of such a statement should be so obvious as to need no elaboration. Unfortunately, there is the greatest need to labour the point, not only as regards the farmer but with a great number of agricultural experts, in whose educational curricula agricultural economics evidently formed no part.

Mr. A. D. Hall states that ("Agriculture After the War," page 30), "from all available evidence, we may conclude that crops from land under the plough, when used for feeding cattle, will produce of either milk or meat more than twice as much as the same land will yield under grass." On the farm mentioned in Chapter I, figures have been obtained proving that the produce from the tilled land—that is the Continuous crops when converted into beef and mutton—is slightly more than three times greater than was produced by the land when in grass.

CHAPTER IV

HOW TO CONQUER THE CLIMATE

REFERENCE has been already made to the difficulties with which the tillage or would-be tillage farmer is faced in connection with climate. It is now necessary to deal more specifically with this factor of climate, and for this purpose I must direct the readers' attention to the fact that the system of tillage usually followed in these countries is either the Norfolk Four Course System, or some modification of it.

Now, the Norfolk System first came into existence in 1730, through the exertions of the second Viscount Townshend, who in that year retired from political life to Raynham, near Fakenham, in Norfolk, for the purpose of taking up the study of agriculture. The main feature of Lord Townshend's system was to combine animal husbandry with crop-growing, two branches of husbandry which previously had been found to be mutually antagonistic.

Prior to his time, land was either left in permanent pasture or doomed to continued corn-growing. For the latter, in order to clean the land, it was left fallow through the entire year at different intervals in the rotation. In some places it was fallowed alternate years. In other cases land, described in the quaint language of the period as "not being by nature foul," was fallowed every third or fourth year. Indeed to-day, in many places still, in the Southern and South-Eastern parts of England, so little progress have we made that it is still considered necessary,

AVERAGE ANNUAL RAINFALL.*

Map showing average annual rainfall of the United Kingdom during the 35-year period 1876-1910. Note.—In several areas where, according to the map, an annual average rainfall of 40″ is indicated, the actual rainfall far exceeds this figure, reaching in some instances 50″ and even 60″.

SPRING RAINFALL.

Composite map showing (for 35-year period 1876-1910) average rainfall during the three-month period, Feb., March and April: "the Tillage months."

*The meteorological charts given here, together with the climatic statistical data in the text, have been obtained from a study of the reports and charts published by the Meteorological Office and the British Rainfall Organisation.

in order to clean land and to make it fit for the growing of a good wheat crop, to leave it idle throughout an entire year.

TO FERTILISE THE LAND

Lord Townshend introduced a root crop—turnips after wheat—in place of the fallow. This crop was eaten *in situ*, so that the manure resulting from the consumption of the crop might fertilise the land for the next crop, and the treading of the animals consolidate the soil and improve it as a seed bed. Turnips were followed by a crop of barley, then grass seeds and clover were sown, part of which latter crop, in the fourth year of the rotation, was also eaten on the land, in order to fertilise it for the succeeding crop of wheat.

Lord Townshend, probably helped by his Parliamentary experience, argued so forcibly in favour of turnip-growing on his lines that he earned the name of "Turnip Townshend." It is interesting and encouraging to other agricultural pioneers to note that in spite of the social position which Lord Townshend occupied, and his forcible advocacy of the new system, there were for years very few people who followed his example. Anyhow he persevered, and the utility of his system, compared with the old fallowing system, was finally recognised, and in time universally adopted.

HIGH PRICES ASSURED

At the time of the introduction of the Townshend system, or, as it is popularly known, the Norfolk system, social conditions were entirely different from

what they are to-day. A high price for farm products was an assured thing, as also were low wages and a plentiful supply of rural labour.

In those days there was little loss from what the writer has called "ineffective days;" viz., the days when, through stress of weather conditions, it is not possible for the farm hands to carry on anything in the nature of land cultivation or harvesting. If weather conditions were bad, the rural labourers, who were paid in either cash or kind, were simply sent home and received no wages for the idle days.

Indeed, in Lord Townshend's time there still prevailed, in many parts of these counties, a system of modified feudalism, by means of which the large land-owner could commandeer the services of the small farmer and his family, and other rural labourers, without any payment. Again, the small farmer and labourer, whose labour could not be commandeered in the manner indicated, had other rural industries, such as spinning, weaving, etc., to which they could turn their attention when weather conditions prevented them from working on the land.

To-day, irrespective of the kind of work performed, and even if it is impossible to carry on any work on the farm, the farmer is obliged to pay the same daily wage to his workers. Again, no matter how well an agricultural labourer is paid to-day, he will not work the frightfully long hours or at the same pace, as did his eighteenth-century prototype.

SLACKNESS OF LABOURERS

This comparative slackness of the present-day agricultural labourer, compared even with the last generation, is the subject of much criticism amongst

JULY RAINFALL.

Map showing (for 35-year period 1876-1910) average rainfall in inches during July.

AUGUST RAINFALL.

Map showing (for 35-year period 1876-1910) average rainfall in inches during August.

the farmers of to-day. Anyone whose association has been of a rural character is familiar with the stories which the old type of farmer tells regarding the number of hours of work, and the amount of work, that the agricultural labourer of forty or even twenty years ago could accomplish.

One listens frequently to such stories, and if, like the writer, they are familiar with the day when, in certain districts at least, a scythe was considered far superior to mowing machine, the old swing plough superior to the modern chill-digging plough, and a

CORRECTION.

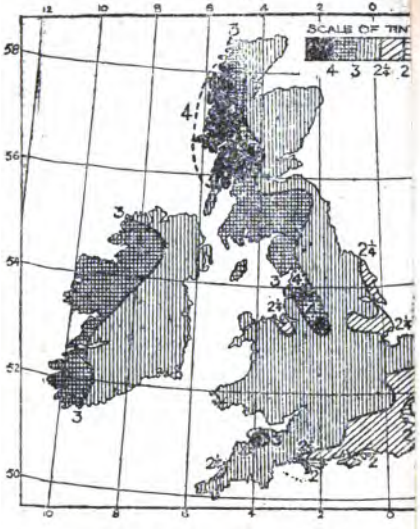
THE MAPS on PAGE 58 should be reversed ; that on the left hand being for August, and on the right hand for July.

case, he can say with conviction, that whilst his own present-day agricultural connection is a perpetual and profitable holiday, he can admit that, had he been compelled to continue working, or slaving, as was customary in his boyhood, he would have long ago abandoned anything in the nature of rural occupation. It is only a mule that can continue doing the work of a mule.

RAINFALL AND TILLAGE

Apart from the altered labour conditions, it is necessary to bear in mind that the Norfolk system and its modifications were started in the Eastern

JULY RAINFALL.



Map showing (for 35-year period 1
average rainfall in inches during July.

GUST RAINFALL.

(for 35-year period 1876-1910)
inches during August.

the farmers of to-day. Anyone whose association has been of a rural character is familiar with the stories which the old type of farmer tells regarding the number of hours of work, and the amount of work, that the agricultural labourer of forty or even twenty years ago could accomplish.

One listens frequently to such stories, and if, like the writer, they are familiar with the day when, in certain districts at least, a scythe was considered far superior to mowing machine, the old swing plough superior to the modern chill-digging plough, and a wooden mattock and spade superior to the disc harrow; when hay elevators were unknown and the corn binders were only in their infancy,—one fervently thanks heaven that they were born so late.

It is a digression, but it is well to bear in mind that much of the slavery on the land, even of the past generation, has, apart from low wages, had the effect of driving not only the labourer and the labourer's family, but also the farmers' sons, from the country into the towns. In the writer's own case, he can say with conviction, that whilst his own present-day agricultural connection is a perpetual and profitable holiday, he can admit that, had he been compelled to continue working, or slaving, as was customary in his boyhood, he would have long ago abandoned anything in the nature of rural occupation. It is only a mule that can continue doing the work of a mule.

RAINFALL AND TILLAGE

Apart from the altered labour conditions, it is necessary to bear in mind that the Norfolk system and its modifications were started in the Eastern

Counties of England, where the average annual rainfall for the thirty-five years from 1876—1910 has varied from 20 to 25 inches, whereas in other parts of these counties, during the same period, the average annual rainfall has been:—

England generally	33·4 inches.
England, excluding the Eastern Counties ..	36 „
Ireland	40 „
Scotland	45 „
Wales	46·9 „

These figures alone should furnish sufficient evidence that a system of tillage suitable for the English Eastern Counties is not suitable for general application, at least on anything approaching an extended scale.

There are also other climatic conditions to be considered. Generally speaking, at least 80% of the tillage operations under a corn and root-growing regime are confined to a brief period during the months of February, March, and April. In the Eastern Counties, or what may be described as the Norfolk area, the rainfall during these three months during the thirty-five years' period already mentioned has been:—

February	1·57 inches.
March	1·61 „
April	1·63 „
Total ..	4·81 „
Average per month	1·60 „

Compare the rainfall in the spring months in the Norfolk area with that obtaining, say, in Ireland, in which country the system of Continuous Cropping has been evolved.

In Ireland, as shown by the following figures, we have nearly double the spring rainfall which is experienced in the Norfolk area, the actual figures being as follows:—

February	3·15 inches.
March	3·05 „
April	2·63 „
Total ..	8·83 „
Average per month	2·94 „

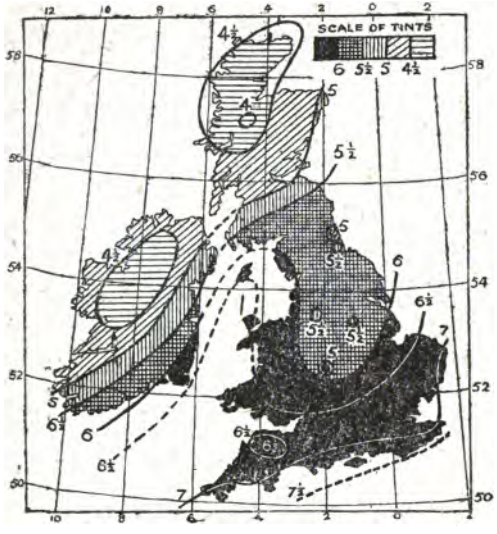
RAINFALL IN IRELAND

The Irish figures are given here, because most of the writer's work in connection with Continuous Cropping has been carried out in Ireland, but a study of the rainfall maps printed in this volume will show that during the period referred to, for the South Western and Western portions of England generally, the whole of Wales, and the Western portion of Scotland,—in short, in any district which, like Ireland, has a high annual rainfall, the spring precipitation, as in Ireland, is far greater than that experienced in the Eastern English counties.

HARVESTING RUSH AND RISK

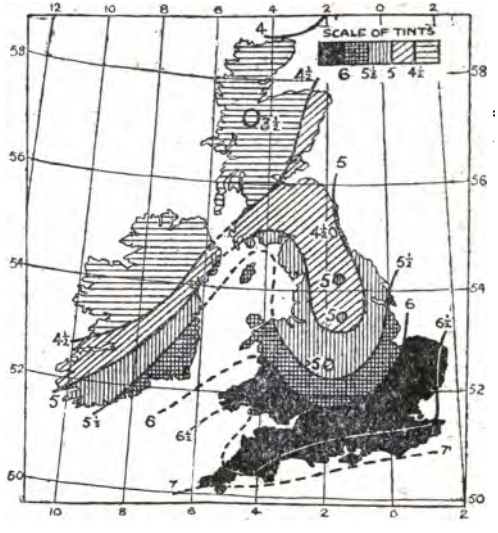
Not only have the cultural operations in connection with the present system of root and corn-growing to be performed during a brief and unsuitable climatic period, but the garnering and harvesting of the crops must also be undertaken under somewhat similar adverse conditions. The month of August is usually the harvest month. Now, in the Eastern Counties of

JULY BRIGHT SUNSHINE.



Map showing (for 35-year period 1876-1910) average daily number of hours of bright sunshine in July.

AUGUST BRIGHT SUNSHINE.



Map showing (for 35-year period 1876-1910) average daily number of hours of bright sunshine in August.

England, which have been previously referred to as the "Norfolk area," the average annual rainfall in August during the thirty-five years' period before-mentioned, has been 2.32 inches. A glance at the rainfall chart for August will show that there is a very big difference between the amount of rain falling in the district referred to and in many large areas of the United Kingdom. There is really only a small section of the South Eastern coast of England where the average rainfall is less than 2.32 inches.

Over about two-thirds of England, the South-East, the Midlands, and the North-East, the average August rainfall is 3.15 inches. The corresponding figures for Wales, excluding a small area on the East and North-East coast, is 3.94 inches, whilst in Scotland, with the exception of a few small areas on the East and North-East coast (where the August rainfall is 3.15 inches) the rainfall for the month mentioned is 3.94 inches. In the remaining area, the Western portion generally, the August precipitation is over 4 inches, as is also the case in Ireland.

In short, throughout the United Kingdom generally, excluding one or two of the winter months, the August, or harvest month, is the wettest month of the year.

Bright sunshine is all-important for the purpose of ripening and harvesting corn. In this respect the number of hours of bright sunshine in the different areas mentioned during the harvest months is worth studying. In the Eastern Counties not only is a comparatively low rainfall experienced, but the area is also blessed with a daily average of from 6 to 6.5 hours of bright sunshine during August, the total for the entire month being 193 hours. The corresponding figure for Ireland is 4.6 hours average daily sunshine, with a total for the month of 143 hours.

A glance at another map given will show that over a large area of Scotland and England conditions as regards the amount of sunshine in August are the same as those in Ireland.

CONQUERING THE CLIMATE

It is beyond the wit of man to alter climatic conditions, but it is not a very difficult thing to alter our tillage system, so that it better fits in with exceptional climatic conditions. Nay more, we can so arrange our methods of cropping that much of the rainfall, which at present hinders tillage operations, will facilitate them.

Further, whilst we cannot cause the sun to shine and to ripen our crops, we can modify our corn-growing methods, so as to ensure our cereal crops receiving a greater amount of sunshine during the ripening and harvesting periods.

We can, in short, conquer the climate, instead of doing as we have done in the past, allowing the climate to conquer us.

CHAPTER V

UNSOUND SYSTEMS OF TILLAGE

In actual practice there are, at the present time, very few districts where the Norfolk, or Lord Townshend rotation, is strictly adhered to. The Norfolk rotation is, as is well-known, a four year rotation, consisting of:—

1st Year,—Winter-sown wheat;
2nd Year,—Roots;
3rd Year,—Spring barley with seeds;
4th Year,—Seeds, hay.

The general modifications which have been made in the Norfolk rotation consist mainly of a substitution of different varieties of cereals for winter wheat and spring barley. In the Northern districts of England, Scotland, and Ireland generally, spring-sown oats have replaced the two last-named cereals. It is also more usual nowadays to extend the rotation to a five, six, or seven-year course, leaving the land a second or third year in grass, generally in pasture. Since roots are only grown once in the rotation, the proportionate area under these crops has decreased.

On this question of roots we shall have more to say later, but, apart from the climatic and labour difficulties previously indicated, the writer argues that, except in districts of low rainfall and light soil, such as prevails on the Eastern coast of England, it is not economically possible or profitable to revive tillage on the Norfolk system, or on its present-day modifications.

There are other reasons why the prevailing system of tillage, when weighed in the economic balance, is found wanting. This, it may be stated, is not a mere theory, but is the experience of most farmers. Otherwise, how is it possible to account for the diminution in the tillage area during the past generation?

DECREASES IN TILLAGE

It is questionable whether it is fully realised to what extent this tillage decrease has taken place. The decrease commenced in the seventies, and was at its worst during the eighties. In the period 1903-1913 the arable area in Great Britain decreased by over 1,000,000 acres, whilst in Ireland during the same period 100,000 acres of arable land went into grass. Some authorities who are afflicted with that fell disease, mental laziness, and who have a great tendency to skim the surface of things, have ascribed the tillage decrease to indolence or ignorance, or both, on the part of the farmer. The practical farmer justly resents these imputations.

It is doubtful whether in Great Britain or Ireland any man has been more in touch with the practical farmer during the last few years than the writer, and, if he may be permitted to give an *obiter dictum* on the question, he has no hesitation in saying that he never found any great difficulty in his attempts to educate the farmer, whether British or Irish, when approached in the right manner. This means letting the farmer, whom one seeks to educate, know that in advocating what may seem very revolutionary methods, one is only speaking about what one has successfully accomplished.

True enough, there are many farmers afflicted with both bodily and mental indolence, and one must admit that in the main farmers—as befits the conservative occupation in which they are engaged—are very critical. Nevertheless, I hold that the more critical they are, the more progressive do they become, once they are convinced of the soundness of any doctrine, tested by practical, and not theoretical, methods alone.

To return to our subject. We can best point out the economic deficiencies of the present tillage methods by taking some actual rotations and studying them in detail.

A WELSH ROTATION

Some time ago the Glamorgan Agricultural War Committee made arrangements for the writer to visit a large number of farms in the neighbourhood of Cardiff, for the purpose of studying in detail the existing methods of tillage, and suggesting improvements on them. The rotation which exists in this district (it is also a rotation which is carried out in many other districts) is as follows:—

1st Year,—Winter wheat;
2nd Year,—Spring oats;
3rd Year,—Roots;
4th Year,—Spring barley with seeds;
5th Year,—Seeds mown;
6th Year,—Seeds grazed.

With the rotation before us it is necessary to study other features of the district. In the first place, the average annual rainfall of the district for the thirty-

five years' period 1876—1910 is a very high one, viz., 41.7 inches. The August rainfall,—the harvest month,—be it noted, is also very high, being during the period referred to 4.5 inches, nearly double the rainfall of the Norfolk area, 2.32 inches.

The average spring rainfall during the thirty-five years' period is also very high, being for February, March, and April inclusive 8.5 inches,—again nearly double that of the Norfolk area, 4.8 inches. Yet, in spite of the disparity in climatic conditions between the two areas, we find the rotations followed very similar in essential details.

It must also be mentioned that the district has a comparatively high winter temperature—the temperature being from October to March inclusive 43.5 degrees Fahr.

Another feature of the farming in the Glamorgan district is that, in addition to corn growing, sheep farming on a fairly extensive, and dairy farming on a less extensive scale, are followed.

ITS WEAK POINTS

The weak points of this rotation, according to the writer's views, may be tabulated as follows:—

(1) Too great a bulk of work is necessary in spring and autumn, especially so considering the high rainfall at these periods. Even under the most favourable conditions, the rotation, as it stands, would necessitate a large amount of casual labour, which is not normally procurable, and often when procurable, is scarcely worth employing.

(2) The system is too risky. A backward season delays the sowing of the crops, resulting in diminished yields, whilst a wet harvest may result, and often has resulted, in the year's tillage crops being partly, or wholly, destroyed.

(3) The land is only cleaned once in every five or six years.

(4) The system of cropping is not sufficiently intensive, there being two whole winter periods when the land is uncropped, and a third period when the winter-sown crop, wheat, is not sufficiently advanced to prevent loss of soil fertilisers.

(5) The great loss of nitrogen and other manurial ingredients on the uncropped land in winter is intensified by the high winter rainfall and the high winter temperature.

(6) There is far too great an area under roots, which, because of the expense involved and the scarcity of hand labour, form an unprofitable crop. Roots are, also, on account of the many pests which attack these crops, a very risky crop.

(7) The rotation does not provide sufficient green feeding, especially for ewes and lambs in spring-time, and does not yield sufficient albuminous food for general feeding.

(8) More atmospheric nitrogen should be fixed in the soil by the growing of more leguminous crops.

(9) The rotation of crops and the disposal of same (corn and straw are largely sold off) result in insufficient humus for the soil. In consequence, the soil, which is of a fairly heavy nature, has become very deficient in humus, and gets into the condition known to practical farmers as "sad," which results in the land being difficult to till, and does not, on account of the humus deficiency, retain either moisture or heat.

The main object of the writer's visit to this district was to suggest an improved system of cropping, and this will serve to illustrate how many drawbacks of the old rotation can be eliminated by modifying the present rotation in accordance with his suggestions.

AN IMPROVED ROTATION

Before setting down the improved rotation, which the writer suggested for adoption in the Glamorgan area, it is necessary to point out that the farmers concerned only undertook to make any change in their present system on condition that the area under corn was not reduced, and that the suggested modifications would not involve a wholesale departure from the existing methods.

Attention is directed to these points, because in the writer's opinion, the modified rotation could be further improved by substituting a greater area of forage and fodder crops in place of some of the corn area, or such crops might well be substituted for what in the district is, by courtesy, classed as pasture.

The suggested rotation is as follows:—

1st Year's Break. Late summer or early autumn-sown corn, grazed in autumn and spring with sheep and inter-cropped with a forage crop of " winter greens."

2nd Year's Break. The forage crop consumed on the land by sheep in February, March, and early April, and then spring oats sown, which in turn would be inter-cropped with a tare crop.

3rd Year's Break. Tares sown as inter-crop in the second year, grazed in the autumn of the second year, and in the spring of the third year, then inter-cropped with " winter greens." The tares in the summer of the third year cut for hay, or ensilage, and the " winter greens " to provide winter feeding from October until the end of March.

4th Year's Break. Spring corn, with which is sown seeds and sainfoin.

5th Year's Break. Seeds and sainfoin first crop " hayed," aftermath ensiled.

6th Year's Break. Seeds and sainfoin pastured, then sown with summer corn as in first year.

A study of the modified rotation will show that, from the beginning to the end of the rotation, the land will be at all times carrying a crop.

During the first three winters of the rotation valuable sheep-feeding, at very hungry times of the year, will be consumed on the land. This will add to the humus contents and the general fertility of the soil, will also keep the land covered in winter, and prevent " leaching " or washing out of the land of plant food.

Not only would the land be improved by such treatment, but also the sheep. In fact, as any successful sheep farmer will readily corroborate, this green feeding in the early spring for ewes and lambs, and a good breadth of green forage in autumn and early winter, for the fattening of hoggets, tegs, and culled ewes, or backward lambs, are absolutely essential for success.

VALUABLE SHEEP FEEDING

It will be noted that under the modified rotation, roots are not included, but apart from sheep, succulent feeding is required for the horned stock. Such succulent feeding is provided in the " winter greens " grown in the third year's break, and by the ensilage made from a portion of the tares, grown also in the third year, and from the ensilage made from the seeds and sainfoin aftermath in the fourth year. The cleaning of the land, instead of being confined to once in five or six years, would be practically continuous throughout the entire rotation. On this latter point there is a feature in connection with Continuous Cropping of the greatest importance.

DENSE FOLIAGE CROPS

Every tiller of the soil must have noted that the time when the weeds make the greatest headway is

when the land is not carrying a crop. Also that the weeds always make their greatest growth amongst any portion of a crop, where, for one reason or another, the crop is poor.

The lesson taught by these observations is obvious. If the land at all times, as is the case with Continuous Cropping, is occupied by useful crops, the weeds never get the chance of becoming established. Particularly so is this the case where such dense foliage crops as giant rape, hardy greens, and other types of winter greens, and also such a smothering crop as tares, are grown.

To put the case in a nutshell. Once a Continuous Cropping rotation is followed, the necessity for weeding is practically dispensed with.

RESULTS: A SMALL CAKE BILL

Where inter-cropping methods are followed, that is, where each crop serves as a nurse crop for the next, there is no necessity for resorting to anything in the nature of hand-weeding or hoeing. Cultivation between the rows of the growing crops, with a triplex cultivator, in order to prepare the necessary seed bed for inter-crop, is sufficient to keep the weeds in subjection.

Another valuable feature of the rotation, and one which has been indicated in an earlier chapter, is the growing of a large bulk of albuminous food. This, no matter what style of stock-breeding may be followed, results in a very small cake bill. Again, some of these albuminous foods, notably tares and sainfoin, have the remarkable power of absorbing nitrogen from the atmosphere, in sufficient quantities as to serve not only for their own nourishment, but

to enable them to store in the soil a good supply of this potent and otherwise expensive fertiliser, for the succeeding crop.

The possibility of obtaining cheap nitrogen in the manner indicated has long been known, but only a few agricultural authorities, and still fewer farmers, have realised it, or at least applied this knowledge to farming practice on anything approaching an extensive scale.

WHY IT IS LESS RISKY

The feature of the modified rotation of special importance is, that not only is such a rotation likely to be profitable, but the rotation is practicable. It is practicable from the standpoint of labour and climate, and what is of equal importance, is far less risky than the usual system of cropping.

To elaborate the foregoing claims at the risk of repetition, a close study of the usual rotation followed in the district will show that, in practice, with the exception of winter-sown wheat, all the crops have to be sown in spring-time, under what are usually atrocious weather conditions. Some preparation of the land before spring-time is possible, such as the ploughing of the lea and stubbles. This latter work, though in actual practice, is often only theoretically possible; and the same may be said as regards the sowing of winter wheat.

In winters like the past—and how many such winters have we had in recent years!—access to all except the lightest of land, except for lea ploughing, has been well-nigh impossible. Throughout these countries generally, from early October, when wheat-sowing is, in theory, being proceeded with, to the

end of November, it has not been possible, through rainfall and the absence of drying winds or weather, to sow one-fourth of the wheat area, which the average farmer, without any compulsory tillage measure, in reality intended.

In the new year the farmer hoped against hope, that the weather would " take up," and give him a chance to sow his wheat crop. The weather in the first half of January continued wet. The wheat which was sown in early October, and that " put down in snatches," after potatoes and roots in November, mostly perished with the constant wet. Then from mid-January onwards came two or three weeks of frost and snow, which lasted to mid-February. The frost then cleared off, the weather for two or three days remained dry, just long enough for the frost to leave the land, then down came the rain again, and continued well into March, when we had another fall of snow.

That winter was undoubtedly rather more trying than the average winter, but there has been a sufficiency of bad weather conditions during what may be termed the tillage decay period to convince the average farmer of the futility of trying to till on the ordinary lines under what are average conditions.

CHAPTER VI

A REVOLUTION IN CORN-GROWING

Before proceeding to discuss Continuous Cropping rotations further it is necessary to study in detail the actual cultural and other operations in connection with the growing of the individual crops.

At the outset, it may be remarked that, whilst it is possible, in a small volume, to give much information in connection with the growing of Continuous Crops, there remain certain features involved which the writer feels entirely incapable of dealing with, either by the medium of spoken or written language.

This is true, as all practical farmers are aware, of all crops. Often the writer has been called in to inspect a crop which for some reason or other unknown to the farmer was not making headway. Immediately the writer has been able to diagnose the cause of the stagnant growth. In other words, one acquires a subtle, innate knowledge in connection with the growing of any crop which it is not possible to put into words, or, perhaps it would be more exact to say, to put into words few enough to be contained in an ordinary book.

Of necessity, therefore, the reader must be content with a few general principles, and must acquire his knowledge in exactly the same way as the writer acquired his—by actually growing the crops over a succession of years, and by facing the many problems

which will arise with that frame of mind that leads one to regard every failure as just another step towards success.

THE WIBBERLEY WAY OF CORN-GROWING

Prior to the war, the writer had devoted most of his attention to the growing of fodder and forage crops in connection with the Continuous Cropping system. The reason for this was that practically all his agricultural work was confined to Ireland. He also held the opinion that the Irish small farmer (85% of the farmers of Ireland, as I have said before, have not more than 50 statute acres of land) could obtain better results by producing crops for subsequent conversion into such easily marketable commodities as beef, mutton, pork, milk, and milk products, rather than by attempting, handicapped as they are by a wet climate, to compete as corn-growers at pre-1914 prices with the foreign farmer.

Even to-day, though corn prices are so much higher than they were before the war, the writer holds strongly to the view that corn-growing on the ordinary tillage system generally is not capable of being extended to any great extent on the old lines. By extension is meant, not an insignificant increase of 10% on the tillage area, but extension which would eventually result in a grass field being as scarce as a tilled field is now.

NO WEATHER GUARANTEE

There is also this point. The present high prices, and the guaranteed prices, only pertain to the corn and other crops when they are safely garnered.

There are no guarantees of weather in which to save the crops, and, so far as England is concerned, as the writer knows from bitter experience, no present guarantee that the labour necessary for the saving of the crops will be available.

If corn-growing is to be genuinely revived, then we must adopt more progressive and safer means of raising and harvesting the crops. We must hammer out some system of growing cereals less dependent on the weather, less risky, and one which does not, as does the present system, demand an unbalanced supply of labour.

PRINCIPLES OF THE SYSTEM

Before dealing with the writer's improved growing system, which later, if one may judge from the favourable comments made by our leading agricultural authorities, is likely to effect a corn-growing revolution, the writer wishes to point out that while he is thoroughly satisfied as to the utility of the system, he has by no means brought it to perfection.

In fact, for many reasons, he would have much preferred to defer writing on the subject for a few years, but the desperate needs of the times compel him to put before his fellow-farmers the results of his experiments, in the hope of inducing others to test his system on a wide scale. Further, these are times when ordinary methods of caution must be cast aside.

Corn is an annual plant, and like other annuals, its natural tendency is to flower and produce seed in one year, and then die off. If this tendency is checked, assuming certain conditions to obtain, the

plant persists in its original tendency to flower and seed, and is convertible into a " biennial."

This phenomenon is familiar to most farmers in the case of annual grasses like Italian rye-grass, which if grazed, instead of being mown, and thus prevented from reaching the seeding stage, will continue to grow for several years.

The fact that an annual plant is convertible into a biennial is one well-known to anyone who has even a very elementary knowledge of botany. But, strange as it may appear,—Agriculture can furnish many such anomalies—no previous effort has been made to turn this elementary scientific fact to practical use. Yet the possibilities in the direction indicated, as will be seen later, are tremendous.

As regards corn-growing, this phenomenon of second growth can be made of the greatest possible utility. It enables the farmer to spread out the labour of land cultivation, the sowing and harvesting of his crops over a very considerably extended period, and, as will be readily understood by the practical man, permits the subsequent cultivation and cropping of his corn stubbles to be spread out instead of being confined to two brief and uncertain periods in winter and spring, when weather conditions are in most cases decidedly against tillage operations *on an extended scale.*

This new system briefly consists of sowing a portion, at least, of the corn break in the previous summer, and other portions in early and late autumn, instead of sowing all the corn in winter and spring. When the corn is sown at the different times specified, the crops ripen at *different intervals.* Hence, in actual practice, *this system means a corn harvest extending over six to eight weeks,* instead of being confined, *as is often the case, to a few days.*

Let it be clearly understood that in advocating a change in the time of year for corn sowing, the writer does not recommend that no corn should be sown at the usual time of year. In recommending the sowing of summer and autumn corn, he does so, not with any idea at present of inducing any decreases in the ordinary corn area, but with a desire to show how the amount of cereals and other crops can be increased by a combination of the existing and by new methods.

The new method, in language easily understood, offers an extra string, or several extra strings, to the farmers' bow.

THE TIME FOR CORN SOWING

The necessary conditions for success for summer and autumn-sown corn, so far as the writer's investigations have gone, are:—

1. A sufficiency of moisture in the early stages of growth.

2. A sufficiency of available plant food.

3. Grain of a hardy nature, with a good tillering capacity.

As regards moisture, it will be seen at the outset that the very weather conditions which are considered to be the most unsuitable for the ordinary system of corn-growing—such as heavy spring and autumn rainfalls and paucity of sunshine in August—are the very conditions favourable to the new system, or to the Continuous Cropping generally.

Summer-sown corn, for the present purpose, may be taken to mean corn sown in July or August. Autumn-sown corn means that put down in September, and early winter corn that put down in October or November.

SUMMER-SOWN CORN

The earlier the corn is sown the greater is the need to pay attention to the conditions mentioned above. Here we come to a very interesting point. In practice, summer and autumn corn will be usually sown on a second or third year's seed lay. Now, for the ploughing and cultivation of land in late June, July, and often early August, it will be found that a considerable rainfall is necessary.

In practice, the summer rainfall very often means hanging up very important hay harvesting operations, and the result is that the whole staff of horses and most of the men are idle, or if not idle the latter are turned on to what has become known in farming phraseology as " fill-up jobs " (white-washing is a very favourite one).

These periods of idleness, or semi-idleness, result in a very great loss to the farmer. *It is exactly under such conditions that the summer corn ploughing and cultivation can be proceeded with under ideal conditions.* The days are long. The soil turns up very friable, and does not require half the harrowing necessary in spring-time to cover in the seed when broadcasted, or to prepare a seed-bed when the corn is drilled.

Further, possibly due to the more rapid growth which corn makes in its early stages when sown at the time mentioned, or because the pests are less active, little trouble is experienced from wire-worms or leather-jacket grubs.

A favourite argument is, that since this system of corn-growing is dependent on a summer rainfall, the farm work in a dry summer may get just as much behind time, and be as much dependent on the vagaries of the weather, as is the case under the ordinary system.

Nothing of the kind. The corn sowing under dry weather conditions may be delayed, but the cutting and saving of the hay and vetch crops may be proceeded with. Also early ripened corn, when once a Continuous Cropping rotation has been established, will be ready for cutting at the time mentioned, July and early August.

IT STARTS THE PLOUGH

In fact, once the system has been established, the farmer will find himself working according to the formula: "the rain that stops the reaper starts the plough."

There is just one other point, but a subtle point, one which few people will realise the significance of until experience points its truth. It is this. As a general rule, a period of dry weather is usually followed by a period of wet weather, and vice versa, so that, in practice, we find a very dry June or July followed by a very wet July or August.

Therefore, to take an example, and one which helps to demonstrate the elasticity of the system, let us say, a dry July happens. What is to be done? Push on with the hay and tare and early corn harvest. Don't worry about the corn. Sow it all in August, or when the weather breaks. Conversely, in a wet July or late June, get rid of the corn-sowing against the time the weather permits of harvesting operations being proceeded with.

All this may read as a very simple explanation, but impossible of accomplishment. But the reader may satisfy himself that the writer is merely stating what is his own experience and is his own farming practice.

A QUESTION OF RAINFALL

As a general rule, in districts with a 30-inch or more annual rainfall, summer moisture, sufficient to permit of ploughing of the second or third year's lay, is not lacking.

For instance, in the British Isles for the thirty-five year period 1875—1910, the average July rainfall has only been less than 2.36 inches east of a line from Hillington, in Norfolk, to Portland Bill, in Dorset, in Lincolnshire, and along a strip of the English East Coast.

During the same period the August rainfall has only been less than 2.36 inches in a small bit of country east of a curve starting at Yarmouth, passing to the East of Cambridge and Rothamstead, and ending about St. Leonards. August, the harvest month, as a matter of fact, is one of the wettest months of the year.

The second condition for the sowing of summer corn, viz., a readily available supply of plant food in the early stages of growth, is all-important. Most of the writer's early failures later proved to be due to ignorance of this essential condition.

Purely owing to the mistake of a workman, who was ordered to go and commence spreading artificials "at the eastern end of a field," and who understood, as is generally understood amongst the Irish peasantry, the eastern to mean the right-hand, a

portion of a field intended for summer corn received a liberal dressing of fertilisers which was intended for another part of the same field just sown with rape.

EFFECT OF MANURIAL DRESSING

The effect of the manurial dressing was most striking. The part unmanured produced a sickly, weakly growth, which " yellowed " in early winter, looked miserable in spring, became very weedy, and, to all intents and purposes, was a failure. The manured portion—the crop was rye, sown on July 12th—gave a magnificent green fodder crop in October, quite 10 tons to the acre, which was fed to dairy cows, and a well-ripened full grain crop of corn out on July 15th in the following year, and yielding 45 bushels (56 lb. bushels) of grain and 2½ tons of straw per statute acre. Yet this field sown in the ordinary manner would have been considered quite rich enough for a corn crop without fertilisers!

The writer's theory as to why summer-sown corn, even on land in good heart, requires artificial manures is as follows:—Land upon which corn is sown in spring-time has usually been ploughed several months before seeding. Hence the turf has an opportunity of decomposing, and being converted into available plant food. In virtue of this the weathering effect incident to winter or early spring ploughing results in additional supply of soluble fertilising elements.

With summer-sown corn the seed is sown immediately after ploughing, and before the turf has had time to decompose, or any weathering effect has taken place. It is, therefore, necessary in order to

nourish the plant in its early stages, to give the crop a dressing of suitable artificial manure, say from 2 to 4 cwt. of superphosphate or slag, and 1 to 1½ cwt. of sulphate of ammonia per statute acre. From 2 to 3 cwt. of kainit may also be added on the very poor or lighter land when this manure is procurable.

THE "LODGING" OF CORN CROPS

Farmers with fairly good land may hesitate about applying a liberal dressing of artificials to lea corn, for fear they may cause the corn to fall or "lodge." Since, however, summer-sown corn will ripen from four to six weeks earlier in the year than spring or winter-sown, and in consequence, usually during far better weather conditions for harvesting, there is far less danger of lodging in the case of the former than in the latter.

As regards the manuring of summer or early autumn-sown corn on medium or poor land, the cost of the artificials will well repay the outlay, as, by forcing on the crops, very valuable grazing for young stock and sheep is ensured for October and November —a very hungry time of the year.

Under certain conditions, the summer-sown crop can with advantage be cut in late autumn for feeding, as soiling to dairy cows, or for conversion into ensilage without in any way lessening the yield of the grain and straw from the crop in the following harvest.

THREE CROPS IN ONE YEAR

A third condition for success with summer-sown corn is the sowing of a hardy variety of corn, with

well-developed tillering capacities, the kind of grain sown being varied according to the time of the year.

For very early sowing the writer's experiments indicated that, of all kinds of cereals, rye is the best. This he has successfully sown as early as June 20th; has cut it for green soiling in early September; cut it again for the same purpose in mid-April; and again, as a grain crop, in early August, thus obtaining two soiling crops and a grain crop from the one seeding within the year.

Rye cannot be cut twice in the manner indicated, except on very rich land, but it is generally better to be content with grazing an early-sown crop with young stock, or better still, with sheep in autumn and spring.

Further, sowing as early as June, except under unusual circumstances, such as the reclaiming of waste or mountain land, or after early potatoes in favoured localities, is not recommended. In ordinary practice, or in ordinary rotations, seed hay would not be cut and carted early enough to permit of such early sowing. The variety of rye which seems best for early sowing is the Giant Essex rye.

SUMMER-SOWN OATS

So far the writer has made no experiments with oats sown earlier than August 1st. Oat crops sown on or after that date have proved very successful, wherever the conditions previously referred to have obtained. The most suitable variety of oats for early sowing so far has proved to be the common winter tawny oats. This oat is very hardy, and has a wonderful capacity for tillering.

No experiments have yet been made with the sowing of winter wheat prior to September. Any hardy winter variety, particularly the bearded varieties of wheat and barley seems to be suited for the purpose. The tillering and hardiness of the chief varieties of these two grain crops, suitable for different localities, are sufficiently well-known amongst farmers as to call for no special description.

RYE AND BARLEY

As far as these experiments have gone, the general recommendations as to the varieties to be sown at the different times in summer and autumn are:—Land ploughed and ready for seeding in July may be sown with Giant Essex rye. (The quantity of seed per statute acre recommended is about 14 to 16 stone of 14 lbs.) Land ploughed and ready for seeding in August may be sown with rye or winter tawny oats at the rate of 14 to 15 stone per statute acre.

The general seeding for winter barley will be from 12 to 14 stone, and for winter wheat 12 to 16 stone per statute acre respectively. The earlier the respective crops are sown the smaller the amount of seed required.

Rye, as a cereal crop, is not, for its grain or straw-producing capacity, as profitable as the other varieties of cereals. Taking into consideration the greater amount of rye as a fodder crop, compared with the fodder yielded by the other varieties of grain, the total value of the various cereal crops will be approximately equal. Further, as previously stated, rye can be sown earlier and will also grow on poorer land than other cereals. For these reasons it offers an opportunity to many farmers of extending the area under cereals.

The subsequent treatment of a summer or autumn-sown corn crop is all-important. The writer's experiments have clearly proved that when a sufficiency of moisture is available in districts of, say, over a 33-inch rainfall, and when the land is in a good state of fertility, any variety of cereals can be cut green before the grain has shot, and will grow again and ripen as a corn crop. It is, however, only recommended, until the results of further experiments are available, that farmers should cut the rye crop for soiling purposes, and that the other crops should be grazed—the early-sown in autumn and the late-sown in spring only.

CHAPTER VII

EXTENDING THE HARVEST

THE actual method of grazing a crop is of importance, and serves as an opportunity of directing attention to another important feature of the new corn-growing system. If a farmer has, say, 40 acres of corn, all sown at the same time, he can, by the exercise of a little judgment in the grazing down of the crop, vary, within certain limits, the time of ripening of different sections of the crop.

For instance, in the case of, say, a 40 acre crop of rye, sown in early July, the 40 acres could be divided into four sections, A.B.C.D., of 10 acres each:—

Section A.	grazed	from	mid. to the end of August.
Section B.	,,	,,	the 1st to mid. September.
Section C.	,,	,,	mid. to the end of September.
Section D.	,,	,,	the 1st to the end of October.

Section D, of course, having the longest period of growth, will be most advanced, and will, therefore, supply a longer grazing period. Section C. also, in most years, will give grazing for three instead of two weeks, it being assumed, of course, that the same number of grazing animals are being grazed throughout.

According to the season, Section A. and B. may be "nibbled over" again during November. Or if by

this month the growth is not sufficiently advanced, these two sections may be left over until the following April. Sometimes they are ready for mid-March, when magnificent feeding for ewes and lambs will be available. Indeed, is there anything under heaven more delightful than ewes and lambs on a fine day in early spring on a field of green feeding?

If this plan of grazing be followed there will be an interval of several days between the ripening of the different sections. Section C. will be ready first, D. follows, then A. and B. The two latter will give the earliest feeding in spring, and be, of course, grazed first, and in consequence will ripen a few days later than C. and D.

The whole aim of this sectional grazing, as is the whole aim of Continuous Cropping, is to divide the labour on the farm—the running of the farm on factory lines.

The possibilities in this direction are many. Beside the sowing of the corn at different times and the subsequent grazing, the labour of sowing and harvesting is spread over a very long period. Such a division of labour at the present time is of the greatest importance.

An even distribution of the labour on a farm throughout the year enables the farmer, during times of stress, to "Carry on," not only to maintain his present area under cultivation, but, with his present staff of horses, men, and machinery, to increase it.

TROUBLE FROM BIRDS

One of the big drawbacks to the system of corn-growing on the above lines is the amount of loss sustained by the ravages of birds on the early-ripened

corn. This difficulty is not insuperable. It is when an isolated plot is sown, and ripens earlier than the other corn in a district, that the greatest damage is done.

The remedy is for a number of farmers in a locality to take up the work simultaneously, so that the attack from birds is not confined to a small area. Seldom, though it may be different in these times of stress, is it likely that a number of farmers in any locality are disposed to take up any new method simultaneously. Generally they prefer to adopt the "sit-on-the-fence" attitude, and watch the results of some pioneer.

In the writer's own case he has surmounted, to a certain extent, the difficulty indicated by confining his early corn sowings to rye. Perhaps because rye is so well bearded, birds do not do much damage on an early ripened crop of this cereal. In the case of oats the loss sustained has been frightful, and in the early experiments the fields of early-sown oats had to be cut in an unripened condition, and made into hay.

With early ripened wheat of a bearded variety, the writer's crops have not suffered to any great extent, but as previously stated, no experiments have yet been completed with very early-sown crops of this cereal.

In practice, in the cooler and wetter parts of these countries—that is, in the slower ripening districts—I have found that, bad as is the damage from sparrows and linnets in the case of early-ripened corn, it is certainly much less than that usually sustained in such districts by late harvests, with the usual accompaniment of bad weather, "lodged" corn, and the damage done by birds.

This bird trouble year by year seems to be getting worse, and perhaps, when we do really seriously set

about our farming operations, some conjoint effort will be made amongst farmers to reduce the pest.

WINTER-PROUD CORN

In certain areas, generally in the southern districts, quite a large acreage of the oat crop is sown in early winter—October and November—in addition to wheat. Without going so far as the writer has done, many farmers in other parts of the country could undoubtedly extend the area under winter oats to advantage.

In districts where the practice is common, and in most districts where any variety of winter cereals are sown, farmers often, in spite of ideal weather conditions, purposely delay the sowing of winter cereal crops until what is recognised in the district as the suitable date.

The writer has often discussed this question with such farmers, and learned that the reason for delayed sowings is to avoid the corn becoming "winter proud," i.e., advanced in growth before bad weather sets in, or, in the case of an open winter, to prevent the foliage becoming very dense in spring-time, and, in consequence, more likely to produce straw than grain.

If there be one thing more than another in our agriculture that can be described as a "bogey," it is this fear of "winter-proud" corn. For one acre of autumn or winter-sown corn which suffers from becoming "winter proud," there are twenty acres which suffer from being sown too late, and, in consequence of bad weather happening when the crop is in a weak state, it is wholly or partially lost.

It is a difficult matter to revive a " winter scalded " crop of corn, but a very simple matter indeed to check any tendency to " winter pride." In fact it would be a step in the right direction for the farmer to try by early sowing and the application of suitable manures, to induce his crops to become " winter proud," and then correct the tendency by " nibbling over " the crop with sheep in early winter.

A far better " stand " would then, under most conditions, be obtained, and the better root development, which would follow the adoption of the practice would, in addition, better enable the crop to withstand adverse weather conditions.

TO ANTICIPATE A RUSH

Before leaving this matter it is very necessary to point out that the summer and autumn sowing of corn, anywhere except in the southern counties of England, and where inter-cropping methods are followed, is absolutely essential if the intention is to follow with a crop of autumn-sown tares.

Even where good weather conditions obtain at harvesting times there is usually such a rush of work in districts where the corn ripens late, say in September, that there is no chance of getting the stubbles cleared, cultivated, and sown with a tare crop sufficiently early for the tares to be well enough advanced in growth to withstand the winter.

Just as happens with the ordinary crops of late-sown wheat, it will be discovered that the late-sown tares have not got a sufficient development of root to withstand bad weather, and, even where they survive the winter, the crop cannot be cut sufficiently

early in the following summer to permit of the sowing of winter greens in time to have the latter fit for feeding in autumn and winter.

Pretty much the same happens throughout the entire rotation. Every crop is behindhand, and the work gets into that detestable condition known in Great Britain as being "on the drag," and in Ireland, in the more descriptive language of "pulling the devil by the tail."

It is to avoid this state of affairs that I wish to emphasise the importance of being early both with the sowing and saving of the corn crop—the first crop usually sown in a Continuous Cropping rotation. Even where an early harvest is induced (for that, in substance, is really what this new method of corn-growing means) the sowing of an *extensive* area of corn stubble is not always possible.

The labour of autumn cultivation can, however, be lightened by adopting the method of inter-cropping, and the use of quicker working implements, both of which are dealt with in another chapter.

CHAPTER VIII

THE GROWING OF TARES

As a general rule, in a Continuous Cropping rotation, a lea corn crop is followed by a crop of mixed vetches and cereals. Sometimes peas and beans are also added. All the different types of mixtures are referred to as "tares."

Tares form one of the most valuable crops in the system, whether the object be the production of beef, mutton or milk. Because of the high feeding value of the crop, and because it contains such a high percentage of proteins, or albuminoids, a good breadth of tares enables the farmer to produce these food products in a very economical manner.

We shall have more to say on this point later, but in passing, it may be remarked, that the reason why the writer was able to turn out, in one year, finished beef and mutton to the value of £5,188 14s. 7d. on the farm referred to in the first chapter, with an expenditure of only £81 2s. 2d. on purchased cakes and meals, was because of the large amount of tares grown and used for green soiling, as hay and ensilage, along with an equivalent area of "winter greens," which also have high albuminous contents.

VALUE OF TARES

There is nothing new in growing tares. In Southern English counties they have been grown from time immemorial, as they also have been elsewhere. There

are few farmers who are not aware of the value of the crop for soiling, and in sheep districts for folding, but few farmers or agricultural experts seem to have realised the possibility of the crop as hay or ensilage, and the improvements in the methods of growing the crop, which are possible.

Not an agriculturist in a thousand is even aware that the crop can be cut twice and even three times in the year, by improved methods of cultivating, manuring, etc. Many, who for years have grown the crop, are of opinion that it is a difficult crop to convert into hay. In fact in tare-growing districts there is an axiom that a man can only hope to make one good tare hay crop in his lifetime.

CAUSE OF FAILURE

The reason for the prevalence of this latter opinion is very simple when one comes to investigate the matter. Invariably far too great a proportion of vetches to cereals or pulse is sown. As a result, the tare crop, when ready for cutting, is a frightful tangled mass of vegetation, presenting great difficulty in cutting and still greater difficulty in curing.

A crop resulting from the usual tare mixture that is sown cannot be cut, with any degree of satisfaction, with a mowing machine, especially in a damp season. Even with the assistance of several people provided with forks to pick up the stuff in front of the mower, and afterwards part the swathes from each other, the task is a difficult one. Often the crop has to be cut with slow and expensive scythe labour, and, when the cutting of such a crop has been finally accomplished, either by machine or scythe, no ordinary hay harvesting implement, swathe-turner, side-

A SECOND CROP OF MIXED VETCHES AND OATS.

This Photo was taken on Sept. 21st. The previous crop was cut on July 12th.

delivery or wheel-rake, can be used for the subsequent curing and saving.

Even where no attempt is made to convert the crop into hay, where the intention is to make ensilage, similar trouble arises. The crop is all tangled, is very difficult to load by hand—it is next to impossible to use a hay-sweep—and, if the stuff has to be chaffed before put into silo, the wet green forage, during the cutting, produces a lot of " soup," chokes the blower, and frequently damages the machine.

AN AGE OF MACHINERY

The policy of the writer, in all his farming operations, is to closely follow the factory idea. If a crop cannot be handled by machinery, then (1) either modify the method of raising the crop, so that it can, and, if this proves impossible, as is to a large extent the case with roots; (2) reduce the crop to a small area, or (3) dispense with it altogether.

CULTIVATION OF TARES

The tare or vetch crop can be introduced at almost any stage in the rotation. It can be sown on the lea or after potatoes or roots, also after a crop of winter greens consumed in springtime, and, as is usual, under a Continuous Cropping rotation, on stubble land after harvest. The crop may also, by the adoption of the inter-cropping system, be sown amongst corn and other crops, before the former are cut.

TIME OF SOWING

Tares can be sown at practically any time of the year—in fact, the crop is probably the most adaptable

crop grown on a farm. The method of cultivating and manuring the crop will vary according to the various circumstances, and the type of crop which has preceded the tares.

TARES AFTER A CORN CROP; CHEAP CULTIVATION

This, in practice, will be the most common method of introducing the tare crop into the rotation. Immediately the corn has been removed, the land is cultivated in exactly the same manner as though for another crop of corn.

In the actual cultivation there is room, under certain conditions, for the exercise of a considerable amount of labour economy. Tares sown in autumn do not require very deep or very elaborate cultivation. Unless the land be heavy or the stubble very dirty, there is seldom need to plough the stubble. All the work can be done with a good grubber, a disc harrow, spring-tooth, and the ordinary harrows and roller.

With the implements mentioned above, all the cultivation necessary for a statute acre of this crop can be done with a three-horse team or a small agricultural motor in about four to six hours.

As a general rule the triple cultivator should be put on the land first, and then followed in the same direction with the disc harrow. Next the two implements should be worked in the opposite direction, so as to cross-cut, rolling first if the land is dry enough. The second or cross-discing should be done so as to give an overlap, or double stroke, of the disc.

This means that the second discing should be done in "setts," the operator travelling round and round as in ploughing, so that the right-hand set of discs

runs over the land cut by the left-hand set of discs during the preceding stroke.

Sometimes it is better to disc-harrow the tare stubble before putting on the triple cultivator. It all depends on the condition of the land. If the soil is fairly dry the cultivator should precede the disc, so as to break the top crust and allow the disc to enter the soil. If the land contains a certain percentage of moisture, and is in a condition known to farmers as "between wet and dry," the disc harrow should precede the cultivator.

Sometimes after cultivating a piece of land, it is necessary to allow the land to dry a little before discing. On the other hand, if the land be dry, one implement should follow the other as soon as possible so as to retain the moisture. It is all a matter of judgment, and to obtain the maximum amount of good for the minimum use of these implements is a matter of skill for each individual farmer.

DOUBLE AND TRIPLE FURROW PLOUGH

Where it is necessary to plough the stubbles, this work can often be done expeditiously by the use of a double or triple-furrow plough. The former implement is common enough in some districts and entirely absent in others. The triple-furrow plough is scarcely known at all.

Apart from Continuous Cropping, these double and triple ploughs should be used wherever possible, as, by their use, a considerable economy of horse and manual labour is possible. In cases where it is possible for two horses to pull a single-breasted plough, the double-furrow plough will generally suffice, thereby effecting a saving of a man and a horse. The makers refer to three-furrow horse

stubble-skimming ploughs, but in practice e found that on two-horse lea land three can pull such a plough on stubble land at quite ent depth for tare cultivation on stubble land, or for ploughing potato land for wheat (seldom with a cultivator and disc harrow is this necessary for wheat after potatoes), or for turning in mangels and turnip tops in preparation for a succeeding corn crop.

Whatever method of cultivation be followed, it is of primary importance in districts of a low rainfall to carry out the work expeditiously. Many failures in the sowing of autumn crops after oats are directly attributable to the dry condition of the stubble land.

DRY FARMING METHODS

Slow tilling under such conditions means drying the land still further. Hence when an autumn crop is sown under dry soil conditions, there is generally just sufficient moisture to start growth, but not sufficient to sustain it, and, in consequence, the crop fails.

Not only should the tillage in the low rainfall districts be quick, but other methods of retaining moisture should be resorted to. For instance, if the area of stubble to be sown is considerable, and the method followed is to complete the cultivation and sowing of one or two acres at a time before touching the rest of the field, it will be found that, more often than not, before half the area has been sown, the balance will have become bone dry, and so hard that it is impossible to get a plough into the baked surface.

The method which should be followed to meet such circumstances is to run over the whole area first with the cultivator and disc harrow, just breaking the top crust and leaving a soil mulch which effectually prevents the land baking underneath. Again, after

sowing a crop (not tares only, but any crop which is rolled), the land in districts of light rainfall should never be left rolled smooth. A light harrow should always follow the roller, so as to roughen the surface, and thus minimise the loss of moisture by checking surface evaporation.

In the Southern Counties of England there are seasons when, even by the adoption of such recommendations, the after-harvest weather may be so dry as not to permit of early stubble cultivation and sowing on anything like an extended area. It is under such conditions, and also, as is the case in the Northern districts, generally, where the harvest is far later than in the South, that the method of corn-growing recommended in the previous chapter so as to ensure an early harvest, and the method of inter-cropping the tares, are likely to prove of the greatest service.

The matter of an adequate supply of soil moisture in autumn has, of course, special reference to low rainfall areas—the South of England generally and the Eastern borders of the three countries. In most other districts there is seldom much lack of moisture during or after harvesting, the trouble generally being, that there is too much.

Still, in the wetter districts, the general recommendation of quick tillage, because of the labour economy involved, holds good.

MOTOR CULTIVATION

There exists a very subtle economic relationship between motors, motor implements, and other expensive machinery and Continuous Cropping. By this system of tillage such machinery can be kept at profitable work for at least 80% of the year, whereas with the

ordinary system of tillage, the machinery lies idle for a very large part of the year, and in such circumstances the large expense involved is scarcely justifiable. It may also be pointed out that the problem of quick autumn cultivation can be effectually solved by the use of a good tractor and its complementary implements.

With a good motor of from 20 to 25 B.H.P., a disc harrow from 8 to 10 feet wide, the discs 20 inches, or better still, 22 inches in diameter, and a strong drag, or cultivator, from 6 to 10 acres per day of stubble land can be got ready for seeding.

Horses are necessary for the final refining of the soil, a spring-tooth and common harrow being used for the purpose. Even when land has already become so dry that the disc harrow when weighted will not penetrate, or when this implement does not suffice to bury the rubbish, a motor disc plough can be used for the purpose. It is precisely under such conditions that a disc plough can work to the best advantage.

TARES AFTER POTATOES AND ROOTS

As previously stated, tares can be sown on the lea —either old lea or new. On such land, ploughing, of course, is essential. The after-preparation of the land and the sowing of the crops are precisely the same as for an ordinary corn crop, and thus calls for no special description.

After a potato crop, the land will very seldom indeed require to be ploughed. The only condition when ploughing is necessary is when the land is either weedy or foul, and the object of the ploughing is to turn in the dirt. After either potatoes or roots, land should, of course, not be foul, but in the rush times

SPRING PLOUGHING A RAPE STUBBLE.

Done with a Saunderson J. Model motor, which is supposed only to haul two furrows, but owing to the dry nature of the soil, consequent upon growing the rape through winter, is here seen hauling four furrows. Note the use of the double furrow horse plough—another Wibberley tip.

in which we farmers have lived for the past few years, it is difficult to get anything done in the manner which a careful farmer likes.

For the ploughing of root or potato land, the double or triple furrow plough should suffice. On potato land, when clean, the sowing of tares is quite a simple job. On the lighter land, the spring-tooth harrow to gather the potato haulms and level the land is all that is usually needed, for either tares or corn, if a disc seed drill is available, for this last-named implement not only sows the seed, but cultivates the land and covers in the seed at the one operation. On stiffer land, a run or two with the triple cultivator alone, or followed by the disc harrow, is all that is usually needed, followed as before with the spring-tooth harrow to level and then with the disc seeder.

Where roots have been grown, turnips, mangels, beet, or cabbages, and where ploughing is necessary to bury the tops, the operations are the same as with an ordinary corn crop. Ploughing will also be necessary for the sowing of tares in spring or summer after "winter greens," in order to bury the stalks and cut up the roots of the winter green stubble.

Tares, of course, can be broadcasted like any corn crop, but since this book is written primarily for the bigger farmer, it is assumed that a corn drill will be available.

THE QUANTITY OF SEED

The right quantity of seed to use is the most important matter in connection with the growing of a crop of tares. Unfortunately, it is not possible to state precise quantities.

Vetches, as is the case with corn, vary very much in their tillering capacity, according to soil, climate,

above sea level, and so on. The one mendation which it is necessary to make sow too large a quantity of vetches." A seed mixture suitable for general purposes

5-6 lbs. of 14 lbs. winter vetches 4 to 5 stone (14 lbs.) winter oats 4 to 5 stone (14 lbs.) wheat or winter beardless barley	Per Statute acre.

On cold or exposed land, rye, which is hardier, may be sown in place of winter oats. The resultant hay will be slightly inferior to that obtained when oats are included, but against this the rye seed gives a surer crop.

If it be intended to use the tare crop for soiling, the quantity of vetches may be increased by a stone or so. Also three stone of beans may be added in place of a stone of the cereal seed when ensilage is the object. The beans help the crop to stand better and make it easier to cut and pass through the blower, when the crop has to be chaffed before ensiling.

If, however, it is intended to cut the crop more than once in the season, the beans should not be included. They do not grow well after being once cut, and, lacking support, the vetches "lodge" and make it more difficult to cut the second or third time.

Where the seed mixture given proves to be too thin, the obvious remedy is to sow a greater quantity of all the seeds. That is, maintain the same ratio of vetches to cereals, unless experience definitely points to the advisability of altering the proportion as well as the total amount.

It should also be understood that the quantity of seed recommended assumes fairly early sowing and the use of a drill. If broadcasted or sown late, the quantity of each class of seed should be increased by about a fifth.

CHAPTER IX

SEEDING DOWN WITH A TARE CROP

In ordinary rotations grass and mixtures are usually sown with a corn crop, following roots, potatoes, or a corn crop, the corn crop acting as a nurse crop for the " seeds " mixture. Precisely the same method may be followed with a tare crop sown after a root or other fallow crop.

Generally speaking, it will be found that a grass seed mixture sown with tares "takes better;" that is, the grass seeds get a better hold of the land, make a more even sward, and give a far better hay crop, or form a better pasture than when the land is sown with a cereal crop. Probably the chief reason of this is that the tare crop is usually cleaned off the land earlier in autumn than is a cereal crop, thus giving the " seeds " greater freedom to become established.

In addition, a cereal crop is very exhaustive of soil nitrogen, but the tare crop assimilates nitrogen from the atmosphere, some of which is used by the tare crop itself, but in addition, the tares store up a good supply of this all-important fertiliser in the soil, and this becomes available for the grass seeds.

The time of sowing grass seeds mixtures with a tare crop will vary according to circumstances. In the case of an autumn-sown crop of tares it is better to sow the grass seeds mixture in the following spring, but before doing so it is usually very desirable

to allow the tares to get about 6″ or 9″ high. Then let them be grazed down with sheep; bush or chain-harrow the crop; sow the "seeds," and cover in the crop by rolling. This method of procedure, though, will delay the cutting of the tare crop by two or three weeks, the delay, of course, being caused by eating the crop down first.

This delay may or may not be an advantage. Under normal circumstances an autumn-sown crop of tares will be ready for cutting about mid-June, and, because of the better weather conditions, the longer days, the greater amount of sunshine at that period of the year, it is better, if possible, to plan for the vetch hay crop to be cut and harvested at the time referred to.

ADJUSTING THE TIME OF HARVEST

In some Continuous Cropping rotations two crops of tares will be included as well as a crop of seeds hay, all of which, under ordinary circumstances, would be ready for cutting in the month of June. If, however, one of the tare crops be grazed from, say, the first to the end of the second or third week of May, the crop will grow up again and be ready for "haying" by about mid-July, by which time the first cut tare crop will be well out of hand.

On the other hand, if circumstances are of such a nature as not to allow of grazing a crop down in the early season, say, for instance, where sheep or young stock are not kept, then there are other alternatives.

A tare crop, in the young stage, although sufficiently advanced in growth, say by the end of May or the beginning of June, to allow of cutting, that is, so far as bulk is concerned, may not be

sufficiently advanced in ripeness to be fit for "haying." The crop may be too full of sap, too immature, and attempts to convert it into hay at such a stage might necessitate an enormous amount of labour and ideal weather to get the crop sufficiently dry for stacking. Even when this is accomplished, the resultant hay will not be near so good as that resulting from a more matured crop.

Cut too soon, the vetches wilt and fall into dust. Under such conditions the alternative methods which can be adopted are either to convert the crop into ensilage or cut it for soiling to cattle on the pastures. In passing, it may be remarked that the best stage of ripeness in which to cut the vetch crop for hay (it can be cut at any stage for ensilage) is when the small seeds in the lower pods of the vetch are beginning to form.

Cutting the vetch crop early for the purposes mentioned, the farmer will avoid an excess of labour at the early hay time, for it is just as necessary to spread out the work in summer as at any time of the year. Just as when the crop is first grazed, the sowing of the grass seeds may be delayed until the immatured vetch crop has been cut and cleared off. This will mean sowing the grass seed mixture about early June, a time of the year when a "good take" of the seeds is an assured thing.

TWO AND THREE CUTTINGS IN THE YEAR

Reference has been made earlier to the possibility of obtaining two crops in the year, a crop of forage and a crop of corn from the one seeding. This is accomplished by grazing the corn crop, or cutting it for soiling, before the corn breaks into ear.

Precisely the same thing happens with a mixed

tare crop, assuming that the land contains sufficient plant food and the requisite amount of moisture is available. The latter crop may be allowed to get three or four feet high, the vetches be in flower, and the corn all shot, and providing it is cut with a high stubble, say about 6″ high, a second growth will result, and in a moist, growthy season even a third, providing also the land is in good condition or is liberally manured. The second crop is quite as heavy, and the third about half as heavy, as the first.

During the past year, for instance, the crop shown in the accompanying illustration was grazed with ewes and lambs in early May; next it was cut for ensilage on July the 11th, and the third crop, or second cutting was as seen in the photograph on September 25th.

Leaving out the weight of the early grazing, a total yield of 30 tons per statute acre of green fodder was obtained which, without going into figures, is quite as valuable as 6 tons of vetch hay or 7½ tons of clover hay per acre. Yet a few years ago, before the Continuous Cropping system was started on the farm, it was considered a fine crop if a yield of 30 cwt. of hay per statute acre was obtained, plus, of course, the aftergrass, which would not be more valuable than the early sheep grazing, which the tare crop had provided.

That a tare crop can be cut several times in a season is a matter of surprise to many people. The crop illustrated was a surprise to a party of professors and other agricultural experts, including practical farmers, who visited the farm on the day the photograph was taken. It would not have been a surprise had the experts and farmers ever thought it worth their while to tackle agricultural questions from the business or economic standpoint.

THE THIRD CROP IN THE YEAR.

Giant Rape sown June 20th—Photo taken Sept. 21st. The previous crop was Giant Essex Rye, and was eaten down by sheep in April, cut for hay late May, and then followed with Giant Rape.

Tares can be sown at practically any time in spring, summer, and autumn. With pre-winter sowings, the crop should, as with wheat and other cereals, be sown in early autumn if possible, and grazed down, if necessary, before winter, so as to ensure a good root hold. After lea corn the tares should be sown not later than mid-October, and if they can be got in, in September, all the better.

EARLY SOWINGS

In the Northern districts of England, Ireland, and in Scotland generally, September sowings on anything approaching an extensive scale are out of the question. Yet, because of the more severe winters in these districts, early sowings are more desirable than in Southern districts. The only way to ensure early sowings is to adopt the practice of sowing the corn in the manner already referred to, or by adopting the inter-cropping principle on at least a portion of the corn stubbles.

Once November has set in it is risky to sow tares on a corn stubble, unless the weather be very open. As with wheat, after a root crop, or on manured land, tares can be sown late in November, or even in December, but just as with wheat, there is always a risk. Late sown tares which experience bad wintry weather have, however, wonderful recuperative power. Often in spring-time a crop of tares which seem to have died out makes a wonderful recovery on the advent of spring weather, and, like a wheat crop, can be wonderfully improved by the usual method of bush harrowing, rolling, and the application of a little nitrogenous manure in spring-time, when the crop has got a fairly good root hold.

a wheat, though, a tare crop can be " darned " aken it up—that is, 2 or 3 stone (of 14 lbs.) of an rye grass can be sown at the time of bush rowing and rolling in order to fill up the bottom.

SPRING TARES

Tares, like spring cereals, can be sown in spring-time, any time from February onwards, when the land is fit to handle. With early spring sowings a winter variety of cereals should be sown, and whilst there are both spring and winter varieties of vetch, the latter are generally the best variety to sow, irrespective of the time of year. Summer tares are usually sown after a crop of winter greens consumed in spring. They may be sown in May or June to give green soiling or to be converted into ensilage or hay, if weather permits in July, August, and September.

MANURING OF TARES

For tares which are autumn or early winter-sown there is nothing better in the way of manure than farmyard manure. Especially is this the case when tares are grown after a lea corn crop, as at this stage of the rotation the land is deficient in humus, and farmyard manure supplies this ingredient in addition to the necessary fertilising elements.

As a general rule though, farmyard manure is not available in autumn on most farms, so resource must be made to artificial manure, but where farmyard manure is available, a dressing of from 15 to 20 tons per statute acre should be applied to the tare crop.

Very satisfactory tare crops can be sown with artificials, and of these a complete mixture is

generally the best for the purpose. By a complete mixture is meant one containing the three dominant ingredients of plant food, nitrogen, potash, and phosphates. A suitable complete mixture for tares would be: From 2 to 3 cwt. of superphosphate, 2 to 3 cwt. of kainit (when procurable), and from 1 to 1½ cwt. of sulphate of ammonia per statute acre. The above may all be mixed together and sown at the same time, although it is an advantage if the land is in good heart to apply half the sulphate in autumn and the other half in spring-time.

On heavy land or on land deficient in lime from 3 to 4 cwt. of basic slag can be used in place of superphosphate, and from 1 to 1½ cwt. of nitrate of soda in place of sulphate of ammonia.

For spring tares on either lea land or after a corn crop artificial manures prove very satisfactory. In the general economy of the farm it is better to depend on artificials for tares sown in spring, and to use farmyard manure for other crops, or reserve it for application in autumn the next time autumn tares are to be sown. The mixture given above will form a suitable mixture for spring tares also.

TARES ON ROOT OR POTATO LAND

After roots or potatoes which have been manured with farmyard manure, no further application of any fertilising matter, either natural or artificial, is required until the following spring. Then the complete mixture of artificials which is given above should be applied.

A farmer would not think of manuring a corn crop which follows a manured root or potato crop, and for this reason would be reluctant to manure a tare crop which had been manured with dung in the

previous year. In fact, were a corn crop to receive an artificial dressing under the conditions mentioned it would, in all probability, "lodge," but with the tare crop it is different. We intend to get two crops of tares, not one, and whilst the residual manure from the potatoes or root break is sufficient to grow one good crop of tares, it is not sufficient to grow two. The second crop, which will result if the artificial manure is applied, will well repay the cost.

In passing, it may be remarked that one feature of forage-crop growing is that it allows of the liberal manuring of land, whereas with ordinary crops, with the exception of such crops as mangels and cabbages, there is always a danger of over-manuring.

VALUE OF LIQUID MANURE

Far better than spring application of artificial manure to tares sown on manured ground is liquid manure. In fact, where the object is the securing of a second or even a third cutting of tares in the season for either hay, ensilage, or soiling, there is nothing better than liquid manure.

The same remark holds good regarding the growing of any forage crop. One almost despairs of agriculture when one observes, as one cannot help observing, how careless the average farmer is as regards his liquid manure. More often than not the liquid is allowed to take the shortest cut to the nearest ditch, from thence into a river, and finally into the sea. More distressing still is the fact that, generally, the poorer the farmer, or the poorer the farm, the less care there is taken about saving this most important fertiliser.

Some few years ago the Irish Department of

Agriculture published the following table, which every farmer should get printed in big type and paste over his mantelpiece:—

TABLE SHOWING COMPARATIVE VALUES OF FARMYARD MANURE AND LIQUID MANURE.

Kind and Quantity of manure	Nitrate of Soda req. to supply an equiv. amount of nitrogen	Superphosphate 35% soluble phosphate req. to supply an equiv. amount of phosphate	Kainit req. to supply an equivalent amount of potash
One ton pure cow urine ..	1 cwt.	¾ cwt.	1 cwt.
One ton farmyard manure ..	¾ cwt.	¼ cwt.	1 cwt.

This table shows at a glance what a potent fertiliser liquid manure is. A ton of liquid manure, we may say, is only about 220 gallons, or about 5½ paraffin barrels full. Exclusive of labour, a concrete tank to catch the liquid manure would not cost more than the price of 1 cwt. of nitrate of soda for every ton of liquid manure which it would hold. The expenditure of about £2 more would buy a chain pump for pumping the stuff into the liquid manure cart. This latter is a fairly costly item (from £16 to £20), but a couple of old paraffin barrels or a big wine cask, having a spigot and hole at the bottom, and put into an ordinary farm cart, or better still, put on to a hay bogie, are all that is needed.

It is a pity that when the principle of compulsion was being applied to the management of land, those in authority did not sufficiently recognise the economy which could be effected as regards the saving of liquid manure, and penalise the man who wasted such a valuable manure.

The application of liquid manure to a tare or other forage crop fits in with the general disposal of the stuff, especially when the crop is being cut for soiling. This, of course, is done in stages, and, simultaneously, the liquid manure tank is getting filled. Once a piece of the land has been cleared the liquid manure can be taken out and applied to that ground. Again, in the winter-time, when the maximum amount of liquid manure is being produced, the liquid can be taken on to a forage crop at any convenient time, and applied to meadows any time the land is firm enough to bear the weight of the tank.

HARVESTING THE TARE CROP

The tare crop can be converted into hay, into ensilage, or used for green soiling to be fed to the cattle. As a general rule, autumn tares sown on a stubble or on lea land, if not grazed in spring-time, will be cut for hay about the month of June, and followed with a summer-sown crop of winter greens, whilst the tares which have been spring-grazed, or sown after roots in early winter, or sown in the spring-time, will not be ripened enough for harvesting until July and August. Then hay-making weather is not so favourable as in June, and, therefore, it is more advisable to convert the crop into ensilage.

This recommendation to make ensilage rather than hay with the later tares must be regarded as a general one, and no hard and fast rule should be adhered to. The farmer should keep before his mind always the farm factory idea—making hay when the weather permits and ensilage when it does not.

CHAPTER X

MAKING VETCH HAY

THE making of vetch hay I have described very fully elsewhere, in a book specially written for the small farmer; * but often the large farmer has a lot to learn in connection with economic and labour-saving methods of hay-making. In this, as in many other respects, there is too great a tendency amongst farmers to walk along the time-honoured groove made by their forefathers. No practical man will lightly cast aside an established custom without very good reasons, but there are very good reasons why the prevalent ideas on the matter of hay-making should be modified.

One great heresy in connection with hay-making is, that if hay is cut with the dew on it, it dries all the quicker afterwards. This and similar statements we have been accustomed to hear from boyhood, and, with the natural tendency of our class, have accepted it unquestioned. One has only to think a minute to realise, however, that a crop standing on the stem has a far better chance of drying, through the agency of sun and wind, than when the hay, be it either grass or tares, is cut in a sopping wet condition and left in a swathe. Further, the swathe, when cut before the dew has dried off, keeps the ground under the swathe damp.

---

*" Continuous Cropping and Tillage Dairy Farming for Small Farmers," by T. Wibberley, N.D.A., N.D.D. London: C. Arthur Pearson, Ltd. Price 2/6 net.

A little experiment on the lines indicated will easily prove to anybody that a crop cut after the dew has dried off will dry all the better and " make " all the quicker than one cut in a wet condition.

THE EARLY START

Of course, in hay-making time, a farmer likes to make an early start. It is probably the desire of an early start which originated the heresy about cutting the grass with the dew on, or more likely to get young lads out of bed about three o'clock in the morning!! In actual practice, it is better not to cut the crop, especially a vetch crop, until the dew has practically dried off, and if necessity compels either early morning or late evening cutting of crops, don't leave the swathe lying for one or more days. As soon as the dew has dried off the swathe, it should be turned over with the swathe-turner and kept constantly stirred up.

Our forefathers admittedly could not have adopted this plan, for the labour of constantly turning was too big a proposition to be tackled by hand. Further, they never liked to break hay out of the swathe (for the reason an undisturbed swathe will turn a lot of rain), until they saw a possibility of getting the hay into cock after the swathes had been once disturbed.

That marvellous invention, the swathe-turner, has quite got over the labour problem associated with hand turning, and has caused another old saw, " Make hay whilst the sun shines," to go by the board. To-day, with a good swathe-turner and side-delivery rake, we can often make hay whether the sun shines or not. In passing, it may be remarked that the farmer whose land is not extensive enough or whose capital is too limited to purchase

both implements, should buy a swathe-turner of the type which can be used as a swathe-turner, tedder, or side-delivery rake.

The modification in our ideas of hay-making referred to are necessary in connection with the saving of an ordinary hay crop, and as regards vetch hay, they are essential for success.

THE WRITER'S HAY-SAVING METHOD

The writer's general plan for saving vetch hay is as follows:—First, so far as possible, cut the crop when the dew has practically dried off. Then, when the dew is completely dried off the top of swathe, get at once the swathe-turner to work, keep the stuff constantly turned, giving the crop about three turns in the first day, and two more in the early part of the second day, in the afternoon of which the crop is gathered in.

This gathering-in consists of throwing the two swathes together with the swathe-turner and thus forming wind-rows. Next, a tippling slide rake is used to run the wind-rows into heaps, and from the heaps so gathered pikes, cocks, or wynds are made.

For such quick work as the foregoing, fine sunny weather is needed. If, at the time, we are not blessed with such weather, the same principle, nevertheless, is followed, that is, the swathes are constantly being turned. In other words, we take advantage of one of the biggest features of a swathe-turner, viz., getting the crop air-dried in the absence of sun.

Sometimes a shower of rain or the falling dew holds up the work at the hand-cocks stage, so that it is not possible to run the hand-cocks together to make pikes. Under such conditions the hand-cocks should

always be "topped off," work generally performed in the evening and then liable to be scamped, if the master's eye is not wide open. The topping off should be done in such a manner that if rain falls during the night, it does not penetrate the cocks. If rain does fall, then the next day, or whenever the weather clears up, the tops of the cocks are lifted off and spread about and then the base of the cock is capsized so as to turn the bottom up to sun and wind.

The making of pikes is a very common custom in parts of Ireland and Scotland, and is well deserving of attention in many other districts. These pikes are built in pyramid shape and vary in weight from 10 to 15 cwt. They are cut off and raked down, so as to turn the rain.

MINIATURE HAY STACKS

To all intents and purposes, these pikes may be regarded as miniature round hay stacks. In these pikes, the hay is allowed to remain for a week, sometimes several weeks, if the carting does not fit in with the general work.

This feature is often of the greatest advantage, for once in the pikes, the hay is fairly safe, that is, of course, if they are not allowed to remain, as is often done in Ireland, until some time in November or December, for no other reason under heaven except carelessness. This tendency on the part of the Irish farmer to leave hay in pike for such a long time caused a witty friend of the writer's to describe them as Asquith cocks—"Wait and See."

The pike system, used with common sense, allows a farmer to push on the work of hay-making. With a small staff of three or four men, equipped with a tippling or tumbling slide rake, one horse, a swathe-

turner or a horse rake, a farmer finds no difficulty in putting a field of hay into pike in one-third the time that it would require to cart it to the stack. In real good hay-weather the intermediate or hand-cock stage is dispensed with, the hay being taken straight out of the swathe to the pike. If it is intended to leave pikes abroad in the field for some time a couple of pieces of binder twine should be passed over the apex of the pike, the twine pegged down at the base of the pike, so as to prevent the conical top being blown off.

USE OF THE HAY BOGIE

An argument which some English visitors to Ireland have put forward against the pike system was that sooner or later the pike had to be carted. That is true, but there is far less labour in building a pike than in loading the stuff on to a cart or waggon, and once in the pike—this is an important point—no further hand labour is required for loading. With a hay bogie, costing, even in war-time, only about £9 or £10, a man and a boy can load the pike on the hay bogie in about two minutes, without in any way breaking up the pike.

The hay bogie is backed against the pike. The body is then tipped up. In front of the bogie there is a drum fitted with a couple of rachet levers. On the drum two ropes are fitted which are fastened together at the back of the pike. Then, by working the rachet levers, the rope winds round the drum or barrel and slides the whole pike *en bloc* on to the hay bogie, when the body of the bogie automatically falls into position, and is held there by a spring clip attachment.

On the arrival at the stack the bogie is backed into position. A touch is given to the spring clip attach-

ment, the body of the bogie tilts up. The horse steps up a pace or two, and the whole pike slides off. Here another advantage of the system comes into operation. There is not half the trouble in lifting hay with a horse fork, that has been allowed to settle in a pike, that there is in lifting loose hay either off the floor or off a waggon or cart. Therefore, there is no delay at the stack with the horses or the man in charge of same.

In other words, two hay bogies with two horses, and two men leading and a boy in the field to help in loading, will bring home more hay in a day than four horses and waggons or carts, with four men leading same and six men in the field loading.

HAY LOADERS OR SWEEPS?

Of course, on many farms nowadays hay loaders are used, and the labour of lifting on to waggons or carts is dispensed with. Nevertheless, it is really only under ideal weather conditions—that is, when hay can be taken out of the swathes without any preliminary rolling together of hand-cocks or pikes—that a hay loader can be used with any degree of satisfaction. If weather conditions are of such a nature that the hay crop has to be cocked, then, before the hay loader can handle a crop with any degree of satisfaction, the cocks have to be spread out.

Again, on a windy day or on uneven land or working against a steep hill, a hay loader does not give very great satisfaction.

All considered, the writer after giving a lot of thought to the subject would prefer to equip a farm with the necessary machinery for making hay on the pike system than to purchase a hay loader and to cart the crop home out of the swathe to the stack.

Under conditions where hay can be stacked in the field where grown, neither a hay loader nor a hay bogie is necessary. The most economical implement for such conditions is a hay sweep, used in conjunction with either a horse fork or a hay elevator.

With a hay sweep, the cock hay can be gathered together and pulled to the rick without breaking the cocks, whilst even a hay pike of 10 or 15 cwt. can be swept along by simply toppling it over in front of the hay sweep.

HINTS ON STACKING HAY

Now, as to the matter of stacking. It is an advantage for hay of any kind to heat a little in the stack, "sweating" as it is called. True, if the heating is too great, the stuff becomes "mow burnt," or may even take fire. But the latter risk is far less than is generally supposed.

Some farmers, on the appearance of a little heat, get into a panic, and begin doing the very thing they shouldn't—pulling the stack to pieces, thus letting more air into the stack which, of course, promotes heating.

Now, the heating of a stack is primarily caused through the action of small organisms, or bacteria, as they are called, and possibly also by the live cell tissue of the hay itself. At all events, heating from one or other or both of these causes takes place up to a certain point. After that, the organisms are killed by the heat, and further heating results from the chemical combinations of substances in the hay and the oxygen of the air.

It should also be noted that these bacteria require a certain amount of moisture present in order to work or bring about heating. Forearmed with the above

knowledge, we can control the amount of heat in a stack. Many farmers who follow the practice of hay sweating know from long experience how much heat is desirable. Their method is largely guesswork, and wherever in farm work we can dispense with guesswork, the better.

Thermometers are cheap enough, and should always be used in stack building. In building a stack, put a long iron pipe in the centre and build around it. Then place the thermometer in this pipe and, by the assistance of a piece of graduated cord, the heat at any part of the stack can be determined. A good maximum temperature to get the stack to is 120° F., which means that if a piece of iron be thrust into the stack and left about ten minutes, the iron on being withdrawn is so hot that it cannot be borne on the back of the hand.

HEATING IN PIKES

Slight heating will, of course, take place in pikes, and when this is on the decline (judged by an iron bar) the hay stacking may commence.

If heating in a pike takes place through moisture, that is damp heating, the pikes should be spread out, dried a little more, and re-made before stacking, otherwise they won't fire but turn mouldy.

Re-heating also takes place in the stack, very slowly at first and rapidly later. The following are the chief points to be remembered in connection therewith:—

First, the slower the stack is built the greater the heat will become. The reason for this is that the stuff is loose and a great amount of air is present.

Well-trampling the stack also minimises the after-heating, since trampling excludes air. Hence, with very dry hay, slow carting seems to be indicated. In

practice, though, one likes to put a little hustle into hay carting, so that, except in the case of the small farmer, master of his own time and work, slow stack-building does not seem to be very feasible.

When slow stack-building is necessary, the best way of carrying it out is to build two stacks at the same time, working alternative days on each.

Where this is not possible, and the hay has got so dry that the after-heating cannot be very great, a load of green stuff should be cut, the outside moisture allowed to dry off, and about 1 cwt. of the green stuff mixed through every load of the hay in order to start re-heating.

THE USE OF SALT

The ideal way of stacking vetch hay is to bring in the stuff dry, but a little green, and to stack it in this condition. That is, as the farmer puts it, "let it heat from its own moisture."

There is, however, a danger of overheating on this system, unless precautions are taken, and the necessary precautions are to sprinkle salt through the stuff while stacking. Use about 14 lbs. of common agricultural salt to every ton of stuff, sprinkling a little salt every time a fresh load is put on the stack.

Salt is an antiseptic, and, therefore, prevents bacteria from working too rapidly, and the temperature rising too high. It might also be mentioned that whilst a useful temperature to obtain in the stack is 120° F., there is no danger if the heat rises to 140° F. when salt has been used, although, if preventible, the stack should not rise past 120° F.

The right thing to do, when it rises over 120° F., is to ram more stuff on at once, which has the effect

of crushing out the air, and thus preventing the temperature from rising. In addition, salt should, of course, be used perhaps a little more liberally than one stone to the ton.

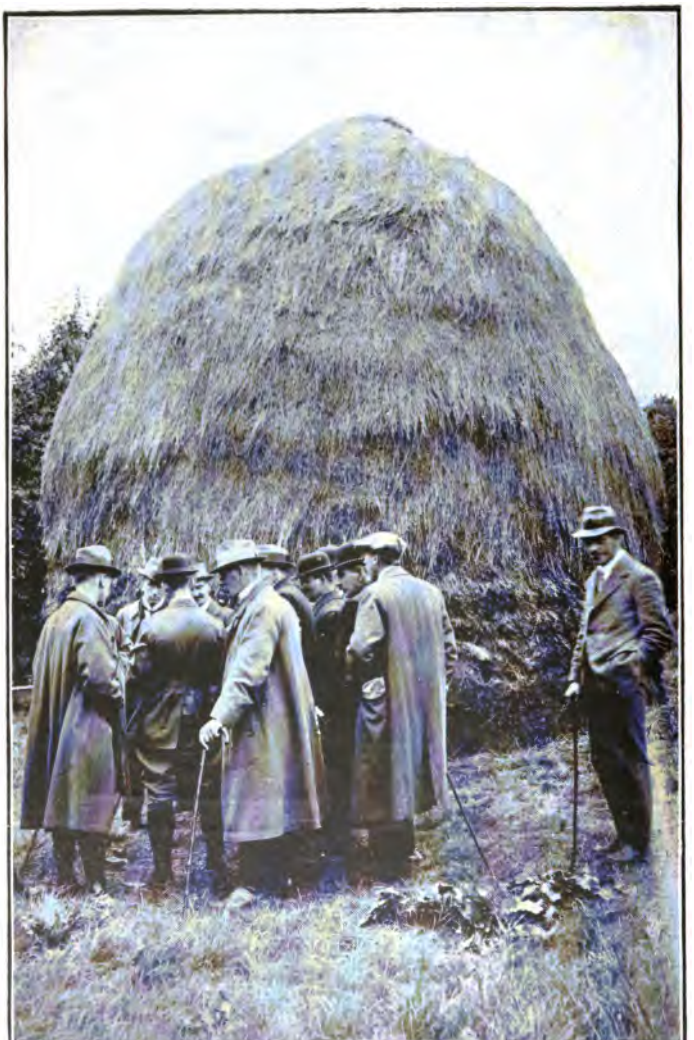
When a stack is *completed*, and when the temperature reaches, say, 140° F. (which should not happen if judgment and salt are used in the making of the stack) it is, of course, impossible to lower the temperature by putting on more stuff. Under such conditions holes may be bored in the stack to allow the heat to escape, but a better thing to try first is a strong brine of salt and water, using as much salt as the water will dissolve, and pouring the water along the centre ridge of the stack.

Made in the way indicated, carted slightly green, with salt used in the stacking, vetch hay makes excellent feeding. It comes out of the stack with a greenish tinge, and with the most beautiful smell. The salt also makes the fodder very appetising to cattle.

ENSILAGE SYSTEMS: NEW AND OLD

In the foregoing, some indication has been given as to the labour economies which can be practised by a modification in various popular methods of hay-making, and by the use of modern machinery. These economies are possible irrespective of good or bad weather, but, as a general rule, unless good weather prevails at hay-harvesting times, it is better rather than waiting for more favourable weather, to convert either vetch hay or ordinary hay into ensilage.

This can be done in broken weather, even if it is actually raining, and for this reason serves as another example of how the Continuous Cropping system enables the farmer to conquer the climate rather than let it conquer him.



A SWEET SILAGE STACK,

Weighted by building a hay stack on top of the silage, and made on the Wibberley method. The author (the central figure in knickers) is explaining his system to a party of English and Welsh experts and farmers.

The writer has adopted a special system of making sweet stack silage for use when weather conditions are unsuitable for making hay. To make sweet stack silage on this plan the forage crop is cut by the ordinary mowing machine. If the crop is " lodged," the work of cutting is facilitated by fitting the machine with a pea harvester.

SWEET STACK SILAGE

To facilitate drying, and the use of the sweep and swathe-turner, the crop is cut so as to leave a high stubble. When the swathes have become a little dry on the upper surface, they are turned completely over with the swathe-turner. Immediately the swathes are turned, they are hauled direct to the stack by means of a small horse sweep, or, if stacking in the field is not possible, by means of a hay bogie or rick shifter. Much less labour is involved in loading the crop on such a low-built conveyance as a hay bogie than on the ordinary farm cart or waggon.

THE ART OF STACKING

The stack is usually built in circular form with a base diameter of from 18 to 24 feet. A layer of waste material is laid on the ground to form the base of the stack. A few sweep rake loads are then tipped direct on to the base, and are trimmed up and shaken into position with a hand fork. After the stack is 3 or 4 feet high, all further lifting is done with the horse fork.

In building, the outer edge of the stack is made to slope slightly inwards, and when a height of about

15 ft. has been reached, and the stack settled, the outer edge is trimmed off with a sharp hay knife—starting at a height of 12 ft. from the ground and cutting slightly inwards—the portion trimmed off being placed on top of the stack. This trimming off is done to minimise the waste at the outside.

The stack should be built as high as possible and, generally speaking, with an ordinary horse fork. This will mean about 15 ft. high when the stack has settled down. In order to allow time for the stack to settle, and with a view to controlling the temperature, it will be found in practice to be a great convenience to build two stacks at the same time. Where there is only sufficient material for one stack of the above dimensions, two smaller stacks should be made, or better still, the operations may be proceeded with at intervals of several days, which in reality means doing the work when weather conditions will not allow of hay-making.

WEIGHTING THE STACK

The ensilage stack may be weighted by building on top of it, when settled, a small stack of hay—a layer of waste material being placed between the silage and the hay. When this is not convenient, the silage stack should be finished off about four feet higher in the centre than on the outside. In a few days the centre will have sunk nearly level.

The stack may then be finally topped off as before described. On the top of the waste layer, soil to the depth of 9 or 12 inches is placed. If the stack is built on a piece of grass land, the turves may be cut all round the stack and placed grass side down on the outer edge of the stack to act as a coping.

There is a considerable amount of labour expended in covering the stack with soil, but labour saving may be effected in various ways. In the first place, hand digging the soil may be avoided by drawing a cultivator or disc harrow round and round the stack until sufficient material has been obtained, while the soil may be raised on to the top of the stack by fitting a box on to the haulage rope of the horse fork.

As the stack settles down, cracks will appear in the layer of soil. These should be closed with a hand rake, using the back of a spade to smooth off.

TEMPERATURE OF THE STACK

Apart from the greater labour required when silage is made on the ordinary plan, there is far less waste in the method here recommended. The silage is sweet, free from mould, very palatable, and when a little experience has been obtained, it may be made so that when the stack is cut into, the silage is almost as green as the day it was carted.

Success depends upon controlling the temperature properly in the making.

This can be done by regulating the rate of building and by using salt. The condition of the forage has also an important bearing on the temperature. If it is green and wet, and is stacked very rapidly without stopping, the temperature will not generally rise beyond 120° F., and the resulting silage will be very wet, sour, and have a most disagreeable smell. If the crop is fairly dry the base of the stack will probably be sour, the middle sweet, and the top may become "browned."

There seems to be far less danger than is generally imagined as regards the possibility of spontaneous

combustion. In order to attain the best results, it is advisable to spread through the stack about 14 lbs. of agricultural salt after the addition of every ton of silage material. When the stack contains about 20 or 30 tons it is left alone until the temperature rises to from 130° F. to 140° F. Immediately this temperature is reached another 20 or 30 tons or so is added to the stack, which is once more left until the temperature reaches the same level, and so on until the stack is completed.

If this is done, and the recommendations as to the use of salt and weighting of the stack are followed, the maximum temperature attained will seldom exceed 160° F. If there is any danger of the temperature exceeding this figure when the stack is finished, the best course is to strip off part of the soil and pour on the stack from 40 to 80 gallons of strong brine. This is, of course, not possible where a stack of hay is built on top of the silage, but if the hay stack is added before the temperature has reached 140° F., no danger of the temperature rising to 160° F. need be anticipated.

The effect of the salt in controlling the temperature is probably due to the salt's antiseptic nature, but on this, and on many other points in connection with silage-making and the chemical changes in connection with same, there is great need for further research.

EXCESSIVE MOISTURE

In continuous bad weather it is sometimes difficult to dry the silage material sufficiently to make silage on the above plan. When this is the case, the best course is to mix with the green material straw or hay left over from the previous year, at the rate of one

ton of dry material for every 10 to 15 tons of the wet forage. In this way the excessive moisture is absorbed.

Very useful silage may be made on the plan outlined, and even hay which has become mouldy in the swathe may be turned to advantage with freshly-cut forage. About one part of such hay should be used with two or three parts of green forage.

As with hay-stacking, the simplest means of ascertaining the temperature is to place in the centre of the stack an iron pipe of about 2 in. diameter, and lower the thermometer down the pipe with a piece of twine, closing the top of the pipe to exclude the cold air whilst the temperature is being taken.

CHAPTER XI

THE SOILING OF TARES

If there be one feature of the Continuous Cropping system, upon which one can speak with emphasis, it is the greater amount of stock which can be fed on fodder crops as compared with pasture.

It requires about two acres of first-class, and from three to four acres of inferior, pasture to summer-feed a dairy cow or any full-grown beast, whereas by devoting the land to fodder crop growing, the stock-carrying capacity of the land can be trebled. The small farmer might well be advised to substitute all fodder crops in lieu of pasture, and the large farmer could, with advantage, devote from 25 to 50 per cent. of his present pasture to the growing of soiling crops for the summer and autumn feeding of stock.

Where the feeding of green food in summer is undertaken—summer soiling as it is called—it is very desirable to arrange for a continuous supply of vetches throughout the summer and autumn. In order to accomplish this, it is sometimes recommended that tares should be sown at different times of the year—an autumn sowing of winter vetches, a very early spring sowing, a late spring sowing, and a summer sowing of spring vetches.

In practice, however, this system of successional sowings is, for climatic reasons, not always possible, while the spring and often the summer sowings must,

CATTLE FED ON A SOILING CROP.

Taken on the farm of Lady Coghill and Miss Somerville, Co. Cork.

of necessity, be made on land which has been left idle throughout the winter. It is also very difficult to include successional sowings in a rotation.

The writer has found it much better to sow in the autumn all the tares required for summer soiling, and to arrange for a continuous supply of green soiling crops throughout the spring, summer and autumn by what may be termed " sectional grazing."

SECTIONAL GRAZING

The advantages of " sectional grazing " may be briefly described as follows:—

All the vetches required for summer soiling are sown in the previous autumn, and generally as indicated after a crop of roots or potatoes. They may also under certain rotations be sown on lea or stubble land.

During the first week in May the " break " is divided into two sections by means of a quickly-erected movable fence (which will be described later), one section being one-fourth of the " break " and the other three-fourths. The smaller section, which is left ungrazed, is kept for soiling in May and June.

When the crop on the larger section is about 9" high, cattle or sheep (preferably the latter) are allowed to graze it. After the entire section has been grazed for about a fortnight the movable fence is moved on, cutting off another quarter from the grazing stock, and a similar course is adopted about a fortnight later, while finally, after a further two weeks, the animals are turned off the remaining quarter.

The object of this sectional " grazing " is to arrange for the *second growth* of tares to come in for use at different times through the summer and autumn.

The system of sectional grazing may be illustrated by assuming a break of 8 acres of autumn-sown tares, divided into four plots, each containing two acres. The following diagram will make the system clear, the dotted lines indicating the position of the movable fence at different times:—

Plot 1.	Left ungrazed. Soiled May and June and again September.
— — — — — — — —	
Plot 2.	Grazed May 1st, May 15th. Soiled July and again in early October.
— — — — — — — —	
Plot 3.	Grazed May 1st, May 31st. Soiled August and again late October.
— — — — — — — —	
Plot 4.	Grazed May 1st, June 15th. Soiled September.

SUCCESSIONAL CUTTINGS

As stated previously, it is not generally known that if tares are cut before the crop is advanced in the seeding stage, or the cereal portion has flowered but not begun to ripen, the crop will give a second and even a third cutting. That is, providing the land is in good condition, or, if the land is poor, quick-acting fertilisers, such as nitrate of soda or liquid manure, have been applied.

Plots 1 and 2 being left to provide further soiling, it is generally advisable to sow a little Italian rye grass at the rate of from 24 to 30 lbs. per acre to fill up the bottom, immediately after the first cutting of these plots has taken place. Chain or bush harrowing and rolling the tare stubble after sowing to cover in the grass seeds and check the weeds are necessary.

There is one point requiring great attention. It is this. When it is intended to allow the tare crop to grow a second or third time, the crop must be cut with a high stubble about 6" high. If cut too low, only a poor successional growth will result, and if the weather is droughty, the bare surface, such as results from low cutting, quickly becomes parched. Again, low cuttings favour the growth of weeds, whereas on the other hand high cutting smothers weeds.

LABOUR ECONOMIES

In connection with summer soiling, it may be of interest to describe the system of feeding the crops, with the object of economising labour. A portion of Plot 1, say, 1 acre, is cut green and fed to the stock either in the yards or on the pasture.

Directly this acre is cleared a movable fence is erected separating the growing crop from the part which has been cut, and every morning the stockman cuts two or three swathes of the growing crop with a one-horse mowing machine, fitted with a corn reaping attachment. This greatly facilitates the labour of gathering the crop. The "sheaves" are thrown over the movable fence.

As the distance from the growing crop to the movable fence increases, the heaps are carted to the cattle on an ordinary hay bogie which is fitted with "creel" sides. There is a great economy in this system of soiling. The carting of the green fodder is reduced to a minimum, but a still greater saving is effected by avoiding the necessity of carting out manure from the houses. In order to distribute the manure properly, the soiling heaps should be spread over the area as evenly as possible.

When it is desired to cut each crop more than once, or when the different plots are tilled and re-sown, a second fence is necessary in order to prevent the stock from unduly trampling the second growth or the succeeding crop. Two strands of wire suffice for this latter fence, if the stock are only allowed to remain on the land whilst consuming the tares supplied to them, but if the stock are fed entirely on the soiling crop—that is, no pasture is available—a three-wire strand fence or a woven wire fence will be necessary.

CHAPTER XII

WINTER GREENS AS A SUBSTITUTE FOR ROOTS

THE term "winter greens" is applied in a generic sense to several varieties of winter forage crops, such as giant rape, hardy green turnips, rye, and various kinds of kale, used either for folding off or for winter soiling crops.

The big features about the winter green crops are:

(1) The necessary cultivation is all done in the month of June, July and early August, *at a time of the year when rain helps, instead of hinders, in the tillage of the land.*

(2) The crops are generally broadcasted, so that costly hand labour is unnecessary, and hand-weeding, horse-weeding, and hoeing are practically, and may, when certain Continuous Cropping rotations are once properly established, be, entirely dispensed with.

(3) An acre of winter greens sown at the times referred to yield as much nutriment per acre as an average crop of roots sown under the *ordinary system*, the former costing no more than one-fourth as much for horse and manual labour as the latter.

(4) Again, the winter greens form the second crop in the year, and, as already indicated, can be so blended with the preceding crop of vetch

hay as to form a properly-balanced ration for all kinds of stock.

(5) The winter greens along with sweet silage are a complete substitute for roots.

THE ROOT OF ALL EVIL

Root-growing as carried out under the present system is far from profitable. The crop is usually sown on a lea oat stubble, which is left uncropped from the time the corn is harvested in August and early September, until the roots are sown in late April or May, and sometimes June of the following year. In addition, the bulk of cultivation for a root crop is carried out in early spring, when, as already indicated, climatic conditions make the cultivation of all except the lightest soils very difficult. Finally, the root crop requires a great deal of labour, especially hand labour, which is very costly, and not always procurable.

WHERE ROOTS PAY

For roots, the land is ploughed in autumn, cross ploughed in spring, then cultivated and worked down to a fine seed bed. At this stage, especially on the heavier classes of land, a downpour of rain may not only stop the tillage operations but may result in a large amount of the cultivation having to be done again. The subsequent manuring, splitting of drills, and sowing, seed-thinning, hand and horse-hoeing, harvesting and clamping, with subsequent pulping, slicing and feeding of the crop, need no description. An estimate may be made on paper to show a profit

from root-growing, but in practice it is almost impossible to grow the crop except at a loss.

In short, roots, from the standpoint of the tillage farmer, might well be described as the root of all evil.

This statement may need a little qualifying under certain conditions. For instance, there are many farmers living adjacent to towns who can often dispose of roots at 30/- to £2 per ton to town dairymen who must use some succulent food for the in-door feeding of dairy cows, and who find roots convenient for the purpose. At such prices, roots are certainly worth the trouble involved in raising the crop, but the general farmer, who is growing roots for home consumption, will find winter greens and silage far more economical than roots.

I have detailed the troubles of root-growing fairly fully, and although it may appear contradictory to say so, root-growing, let it be carefully noted, on a limited scale, can be made profitable, provided that the roots are grown on the Continuous Cropping system. This point will be elaborated later.

DRY FARMING METHODS

In most Continuous Cropping rotations, winter greens will follow a crop of tares sown in autumn on the lea, or after a lea oat crop, which crop has been cut for hay, soiling, or ensilage in June. Winter greens can also be introduced into the rotation by sowing the crop on the lea in June and July, the lea land having been ploughed in the preceding spring and part summer fallowed.

In connection with the summer cultivations and sowings of crops, there is one matter which requires every attention in order to ensure success. The summer tillage of land is quite a distinct thing as

compared with the ordinary spring cultivation. The farmer's main object in connection with the latter is to get his land dried sufficiently to allow of a fine tilth being obtained. To do this, he is very careful, especially if the land is in any way heavy, not to touch soil in a damp condition, whilst to till such land while rain was actually falling would be viewed in the light of an insane act.

With summer tillage, the case is entirely different. The whole principle must be reversed. Instead of allowing land to dry out before tillage operations are commenced, every measure should be taken to retain the soil moisture even to the extent of tilling the land during rainy weather. This, of course, on heavy land and in a wet summer can be overdone, but the practical farmer will realise that tillage operations, even in summer, must cease during wet weather, if such operations result in the land being made pasty.

QUICK CULTIVATION ESSENTIAL

From the foregoing, it will be understood that, for the successful growing of winter greens or any summer-sown crop, we must adopt the methods known in other countries as dry farming. For dry farming, or the conservation of soil moisture, quick or rapid cultivation of land is essential. For instance, if a farmer were to set about the cultivation of, say, 20 acres of tare stubble on the ordinary plan to which he has been accustomed, he would probably first plough the entire area; next he would give the ploughed land a run with the harrow or cultivator; then proceed to cross-plough the whole area, and repeat the harrowings and cultivations, completing one operation before commencing the next.

This means in practice that between every two cultural operations the land is losing a large amount of moisture, and by the time the tare stubble is reduced to a fine tilth (it must be understood that we are dealing with the cultivation of a stubble in summer time) the land is as dry as a bone. Further, working on his ordinary plan, the farmer, if it commenced to rain whilst the various cultural operations were being undertaken, would immediately cease work.

Working according to dry farming methods, the farmer, under the circumstances outlined, would, however, undertake the cultivation of the tare stubble in sections, ploughing one or two acres and reducing the ploughed sections to a fine tilth as quickly as possible. This means retaining the soil moisture as much as possible.

Suppose, though, that very dry weather obtains when cultivating the tare stubble on the latter plan! Then, by the time the cultivation of, say, a quarter has been completed, the remaining three-quarters will be baked so hard no plough would face it. In order to guard against such a contingency, it is necessary to form a soil mulch on the unploughed portion, with a view to reducing moisture evaporation to a minimum. This can be accomplished by roughening the surface of the stubble by passing the cultivator or disc harrow, or both, once or twice over the land before ploughing. The disturbed surface acts like a blanket and reduces the evaporation of moisture from the lower layer of the soil.

TO CONSERVE SOIL MOISTURE

After the land has been tilled and the crop sown, there are still other methods of dry farming to be

adopted in order to conserve soil moisture. In fact, for the successful growth of summer-sown winter greens, even in districts of comparatively high rainfall, moisture might be regarded as the dominant requirement.

Under the ordinary system of tillage, a farmer invariably ploughs in his farmyard manure, but in nine out of ten seasons, spreading dung on the top of the land, after the cultivation and sowing of winter greens is completed, proves more successful than when the dung is ploughed in.

On this point last year the writer had the pleasure of a visit from a party of English and Welsh experts. The visitors were shown a field of about 20 acres of winter greens. At intervals of about 40 yards wide, on the date (September 25th) when the visitors arrived, there were strips of winter greens not more than about six inches high, whereas on the remaining parts of the field the crop was three feet high.

It was explained to the visitors that the land had all been manured and treated in an equal manner, and they were asked to give an opinion as to why there was such a great disparity in the crop. So little is the importance of dry farming in connection with the Continuous Cropping system understood, that not one of the thirty visitors gave the right explanation.

QUICK TILLAGE

Yet the explanation was quite simple. The part where the crop was so luxuriant had first been tilled, the tillage being done as quickly as possible. Then the crop was sown and the farm-yard manure was applied and spread on the surface. Most of the

spreading was done with the chain harrow, which mixed the manure with the top layer of soil, and hence formed a soil mulch. The remaining portion, where the crop was backward, had farmyard manure carted on, ploughed in, the land then cultivated and the crop sown.

The cultivation of the entire field was undertaken during a period of very dry weather. Hence, whilst the manure was being carted on and spread on the backward portion of the crop, the soil got very hard and dry. Having become dry, it was absolutely imperative to plough the land, which meant further delay.

The difficulty in ploughing the land was considerable, although a steel bar-pointed plough was used (no other plough would have faced the baked surface). Further difficulty and delay was experienced in reducing the soil to a fine tilth. On the other hand, the cultivation of the more forward portion of the crop had been done entirely with the disc harrow, the triple cultivator and the spring-tooth harrow, which it may be here remarked did not involve one-fourth the labour that was required for the part that had to be ploughed. The cultivation, as well as being more economical, was very much quicker. A fine surface having been obtained, the seed was sown immediately, the manure, as already stated, being carted on and spread.

This meant that we cultivated and sowed the more forward portion some ten days earlier than the backward portion. The sowing of the whole area, it should be mentioned, was completed by the end of June; the crop was inspected on the 25th of September; and although we got moisture in plenty from about mid-August onwards, the later-sown parts never recovered. The crop had become stunted in

its early growth, and when moisture resulting from later rains was available, it was too late to be of much use to the stunted crop. In fact, in the month of December, the quickly-tilled portion was quite four feet high, whilst never, during the whole season, did the backward portion present a swathe high enough to cut with the scythe.

MORE SOIL PHYSICS

As is generally known, but apparently not sufficiently appreciated, the finer the tilth produced in any crop the more retentive the soil is of moisture. This fact requires to be kept well in mind, especially in connection with summer tillage.

Another feature of soil physics is that a soil finely tilled and then heavily rolled will draw up more moisture from the sub-soil and retain more dew moisture than a soil equally finely tilled and not rolled. But a subtle point to be remembered is, that while it is necessary to roll a finely-tilled soil in order to reduce capillarity, the moisture will evaporate more rapidly from a smooth than from a roughened surface.

A practical demonstration of this phenomenon may be made by pouring equal quantities of water on two boards, one rough-sawn, and the other smooth-planed. It will be observed that the moisture from the smooth board will dry off much more rapidly than it will from the rough-sawn board. The deduction to be made from this is very simple—viz., tillage must first be very thorough, then the soil must be heavily rolled, but after the rolling the harrow should be passed over the smooth surface in order to roughen same, and thus check the evaporation of soil moisture.

The importance of dry farming methods in connection with the growing of summer-sown crops has been dealt with at considerable length because of its great importance. Many farmers, whom the writer has visited in the drier districts, have not made a success of winter greens for no other reason than that sufficient attention has not been paid to the conservation of soil moisture. In fact, in dry summer rainfall districts, one may regard the adoption of dry farming methods for the growing of summer-sown winter greens as the beginning and the end of success.

CHAPTER XIII

HOW TO CULTIVATE WINTER GREENS

Let me now discuss the different types of winter greens in detail. In this, as in any other feature of the Continuous Cropping system, the reader must be content more or less with general statements. In other words, it is for the farmer to ascertain, by trial, which of the different type of winter greens are best suited for his particular purpose.

The hardiest of all the types of winter greens is rye, and of all the different varieties at present in existence, there is none more hardy and productive of more foliage than that known as giant Essex rye.

When the writer was a boy he distinctly remembers a variety of rye known as St. John's Day rye, which for luxuriance of growth, hardiness, and perennial habit was even more valuable than giant Essex rye. For some reason or other, this variety seems to have gone out of cultivation, or, at least, is no longer procurable. It is to be hoped that some seedsman will again take this variety of seed in hand.

Not only is rye very hardy, but the use and consumption of rye crops may be very varied. In the chapter on corn-growing, some reference has already been made to the growing of rye as a cereal crop, and using it first as a soiling crop in late autumn, and again in early spring.

SOILING BULLOCKS

in late Autumn with Rape on one of the Author's Continuous Cropping farms. Note the hay bogie.

For this purpose rye is usually sown in late July or early August, but it can be sown still earlier, say, before midsummer, and cut green in the month of September for soiling to cattle. June-sown rye by the latter month will be about a yard high, and will yield from 12 to 15 tons of green food per statute acre. Then, if manured immediately (preferably with liquid manure), it will give good sheep grazing by the first of the following April, or it could be cut for a green soiling crop again about the third week of April.

If green soiling at the time mentioned is not required, then the crop can be cut twice for the purpose of conversion into sweet ensilage. Also it may be cut in autumn, or soiled or folded in autumn, but in the latter case it may be folded again in April, and about a month after the sheep have been removed, so quick does rye grow, it can be cut for a hay crop. The land may then be broken up for a crop of rape or hardy green turnips, to be sown in June.

Another characteristic of rye is that it grows at a lower temperature than any other kind of winter greens.

SOWING RYE

The sowing and cultivation of rye is quite a simple matter. The crop is sown in exactly the same way as an ordinary corn crop, the seed required being 16 stone per statute acre. As regards manure, from 15 to 20 tons of dung should be applied, or a mixture of 3 cwt. of superphosphate, 3 cwt. of kainit (when procurable), and 1 cwt. of sulphate of ammonia, per statute acre. If the crop is

folded only, no further manure is required, but if it is to be cut and carted off the land then it should receive an additional dressing of from 10 to 15 tons of liquid manure per statute acre.

CULTIVATION OF KALES

There are many other types of winter green crops, but the chief ones used by the writer are giant rape, hardy green turnips, thousand-headed kale, marrow stem kale, and other varieties of kale. In point of hardiness, the kale crops come next to rye, but all the varieties of kale are slow in their initial growth, which necessitates a difference in sowing to the method followed in the case of giant rape and hardy greens.

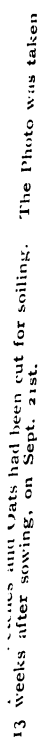
Kale crops are not sufficiently quick-growing in their early stages as to be included in the category of smothering crops—crops which smother weeds. Hence, except on clean land, the kale crops should be sown in rows to permit of after-cultivation.

The after-cultivation consists entirely of horse and implement labour. Costly hand labour, such as is necessary for the growing of roots, is not required. The fact that the kales are slow in their initial growth, whilst being a disadvantage in one way, is in another an advantage. By adopting methods of inter-cropping, the kales can be sown in a crop of corn whilst that crop is still on the land, without any danger that the kales may grow so vigorously (which sometimes happens with rape and hardy greens when used for this purpose) so as to interfere with the harvesting of the corn crop.

FIELD OF MARROW STEM KALE MIXED WITH GIANT RAPE.

It was sown on June 20th, after a crop of Vetches and Oats had been cut for soiling. The Photo was taken 13 weeks after sowing, on Sept. 21st.

Of the kales, marrow stem kale, which is a hybrid between thousand headed kale and kohl rabi, is the least hardy, but at the same time quicker in its growth than other kinds of kale. It is especially valuable for dairy cattle, the thick stalks which it produces being very nutritious.



13 weeks after sowing, on Sept. 21st. The Photo was taken

MARROW STEM KALE

When sown in the months of March or April, marrow stem kale gives excellent feeding in September, and if the crop is then cut in such a manner as to leave a stalk about six inches high, or if grazed with sheep or cattle and a sufficiency of stalk is left, the crop will give a second growth of valuable grazing for the following spring, unless the winter be very severe.

Sown in early June, the crop will be ready for consumption during the months of October, November and December. If sown in early July, it can generally be depended to provide good feeding from late February onwards.

In the northern parts of these countries, marrow stem kale is not sufficiently hardy to withstand the severe winter. Therefore, when sowing in these districts, the farmer should plan to have the marrow stem kale consumed before Christmas.

There are two varieties of marrow stem kale—the green and the purpled leaf. If there be any difference the former seems to be more vigorous of growth than the latter. One outstanding feature of the crop is its drought-resisting properties. For this reason, preference should be given to it in districts where the annual rainfall is 25 inches, or where the rainfall is even heavier, but the soil porous. At the same time, it

should be understood that in any district of heavy rainfall and heavy soil, marrow stem kale grows most luxuriantly.

THOUSAND HEADED AND CURLY KALE.

These varieties of kale seem able to stand the severest winter, and for this reason a good breadth of these crops should be sown in the colder districts to provide food in the early spring months, say from February onwards. Like marrow stem kale they may be sown at any time of the year from March onwards.

They are slower in their growth than the marrow stem varieties, but if sown early and cut in late autumn, provided the land is rich or well manured, the kales will give a second growth in the following spring. In fact, on this point it is useful to note that any of these cruciferous crops, if cut before reaching the flowering stage, will give a second and even a third growth.

Like marrow stem kale, the crop can be grown by transplanting the plant, but transplanting, except on a small area, is seldom possible because of the labour involved.

GIANT RAPE

With the possible exception of white mustard, giant rape is the quickest growing of all cruciferous fodder crops. With well-tilled, well-manured land, in a moist summer, the writer has often grown it four feet high in the space of twelve weeks, getting a yield of from 30 to 40 tons per statute acre.

Growing so quickly, this crop, as well as hardy green turnips, completely smothers out every weed, except charlock, and leaves the land in a beautifully

clean condition. Like the different types of kales mentioned above, it is more nutritious than either mangels or turnips, whilst its manurial value is two and-a-half times greater than either mangels and turnips. All kinds of stock are fond of the crop.

When intended for autumn or early winter use, giant rape should not be sown later than, say, the 13th of July, and if it can be got in by the 15th of June, assuming that the soil and weather conditions are favourable, all the better. As with most of these crops, the best results can only be obtained by liberal manuring.

Liberal manuring of farmyard manure is not possible in many cases under our present system of farming, because of the small amount of stock carried, the usual standard being the equivalent of one full-grown beast to every three or four acres, whereas by growing more fodder and forage crops as has already been indicated in these pages, double the quantity of stock might be carried.

Giant rape is not so hardy as any of the crops previously mentioned, but is hardy enough to withstand any average winter, except in the northern and eastern portions of these countries. The capacity of winter green crops for withstanding a severe winter, especially giant rape or hardy green turnips, depends much on the time at which they are sown. If well advanced in growth, say four feet high, they will withstand a severe but not a long frost. Even a long frost may not kill the crop, but cause the outer leaves to wither, yet on the advent of mild weather in spring, the crop makes a wonderful recovery.

Sown about mid-August, giant rape or hardy greens will be about 9 to 12 inches high by the time winter sets in, and at this stage in their growth both crops will withstand very severe weather. Late summer

sowing, though, may result in land lying idle for four or five weeks in summer. Some farmers would not object to this, as it gives them an opportunity of partly summer-fallowing the land, but where the object of fallowing either partly or wholly is to clean the land, the writer's view is that fallowing is not worth while. The land can be far better cleaned by growing a crop like rape or hardy greens.

Both giant rape and hardy greens require a fair amount of moisture, and in districts of a rainfall of over 30 inches, preference should be given to these crops as compared with marrow stem kale and other varieties of kale, especially in the southern and western areas of those counties, where the winters are generally milder than in the northern and eastern sections.

HARDY GREEN TURNIPS

Hardy green turnips, when broadcasted, have in their manner of growth all the appearance of a hybrid between white turnips and giant rape. The crop grows a bulb like a turnip, and will grow a top of dense foliage from three to four feet high, like rape.

Like rape too, when sown under suitable conditions, it is very quick-growing, and requires a fair amount of moisture. It will not stand frost or dry weather as well as the different varieties of kale.

On the question of moisture, it may be remarked, in passing, that once the plants are well established, there is not much danger of their suffering from drought, unless in exceptionally dry years. Even in districts of low rainfall there is, in fact, generally in late autumn, winter and early spring, more moisture than the average farmer wants.

It is sometimes a decided advantage to grow a mixed crop of winter greens. For instance, the kales, as has been previously stated, are not sufficiently quick in their early growth as to form weed smotherers, and for this reason when sown alone, must generally be sown in rows.

MIXED WINTER GREENS.

Sowing in rows is, of course, done with the object of subsequently cleaning the land by horse hoeing, but instead of sowing in rows, a mixed crop of kale and rape in equal parts can be sown together. The rape will keep the land covered until the kale is firmly established. Again there are some winters during which giant rape seems to be better able to withstand the frost (and what is equally destructive, cold wet prolonged), than are hardy greens, while during other winters, which are equally severe, the rape may be injured and the hardy greens untouched.

At present it is impossible to account for these variations, but from practical observations, the writer has found that a mixture of hardy greens and rape sown together will, in most winters, better stand hardships than either hardy greens or rape sown alone. For this reason, whilst it is an advantage sometimes to have a portion of the land devoted to each separate crop, it is desirable, if a large area is being sown, to mix the seed.

RYE AND RAPE—WINTER PASTURE.

Under a certain condition a crop of mixed rye and rape also proves more useful than either crop sown

alone. The condition referred to is where it is desirable to form a winter pasture for sheep, young cattle, or matured stock.

Rye, sown alone, would, in damp weather, get very much trampled by the stock, and, even in a comparatively dry winter if not grazed, would "lodge" and rot at the bottom. The rape helps to support the rye, and prevent "lodging." A mixture of rye and rape is very suited for land sown, say, in late July or early August, or even late August.

In passing, it may be remarked, that a winter pasture in mountainous districts, or in fields not easily accessible, is one of the most valuable features of the Continuous Cropping system. For a farmer to be able to turn his sheep and young stock—and, if the weather is any way dry, his older cattle—on to new pasture during October and November and during February and March, means lightening the labour of feeding the stock, and increasing, to a considerable extent, the stock-carrying capacity of his land.

Especially is this the case with the sheep farmer. On one of our farms, we have every year such pasture ready by about mid-September. At this time of the year, the ewes and rams are mating, and they are turned on to the pasture during the mating season. As a general rule, we allow from 100 to 120 ewes to every ten acres of the winter pasture. The sheep are put in folds, not the small miserable folds that prevail in some sheep-raising districts, and which become quagmires after a couple of days grazing, but folds of about five acres to every 200 sheep.

One five acre section will be grazed down in September, another in October, and another in November. Then the sheep are turned on to other land, and the different sections starting with the one first grazed, will come in for use, respectively during March, April

and May. Because rye grows at a very low temperature, it is always included in these winter pastures.

From the foregoing, it may be seen that, with the exception of December and January, our sheep are always on green food throughout the winter. This means that ten acres of land will feed 100 ewes and their spring-born lambs through the winter, with the exception of a little hay which they receive during the two months of December and January.

This past winter has, in Ireland at least, been one of the severest in the writer's memory. It has been very wet. We have had in addition, three periods of frost—one in early December, one in January (which was so severe that the lake in front of the house had six inches of ice on it), and another in late January. Still, as this chapter is being dictated on the 9th March, the ewes and lambs are being turned on to a field of rye, sown on July 15th last season, and grazed in sections from the 10th of September to the 21st of November. Other flock-masters are lamenting a shortage of keep. Yesterday in Armagh, within ten miles of the farm in question, we were told about ewes and lambs dying for want of food, whilst we have food in plenty.

Our first grazed plot of rye is over six inches high and a remaining ten acres of this crop will be available for consumption after the first plot has been eaten off.

RAPE PASTURES

Another example of a mixed winter green crop is one consisting of rape and a little kale with Italian rye grass. The particular conditions under which this mixture proves most valuable are in colder districts

where the crop is sown early, say, in the month of June.

Sown at this time, the crop when properly manured, and tilled, will be from three to four feet high at the beginning of October. Such a luxuriant crop in cold districts must be used up before the advent of December, as, if left out through the winter, the rape portion of the crop, if not entirely killed, may be partly destroyed. After grazing down during October, November, and early December, the rape and kale portions of the crop in cold districts will not make much growth by the following spring, but the rye grass, even if the rape be entirely destroyed, will, in most winters, give valuable sheep feeding in April.

If, as may happen in a backward spring, the rye grass does not make sufficient headway to permit of much grazing, the crop is, nevertheless, valuable to turn in as green manure. There are, however, very few districts, where rye grass sown in the manner stated and properly manured, will not give good sheep grazing by late April.

Proper manuring means in this particular case, to have the land in good heart to begin with, and then to apply a good dressing of a quick-acting manure like nitrate of soda in early spring. For such a crop it is recommended to give about 1 cwt. of nitrate of soda in mid-February, and a similar dressing in the first week of March. In theory, it is urged "that nitrate of soda should not be applied until the spring is well advanced and growth has commenced," but there are many theoretical things written in books which do not coincide with practice. The idea of delaying the application of nitrate of soda is to avoid the washing out of the land of such a soluble manure, but there is little loss in this direction, if the land is carrying a crop.

Again, as regards the application of nitrate of soda until growth has commenced, the writer is convinced from practical experience, that a liberal application of nitrate of soda will actually commence growth two or three weeks later than would be the case if the nitrate of soda were not applied.

CHAPTER XIV

WINTER GREEN ENSILAGE

There may be some difficulty in getting the crop consumed before the advent of winter in the northern and eastern districts of these counties, where a large area of winter greens, consisting of giant rape alone, or where the crop consists of a large proportion of this type of winter green, may have been sown, and the crop is well advanced in growth at the beginning of October. In these areas it is often risky to leave a crop of this type to stand over the winter.

Under such conditions it is a decided advantage to be able to convert the crop into sweet ensilage. There is no difficulty in doing this if there is on the farm either a silage pit or, better still, a circular or American stave silo, provided that the material is chaffed when being put into the silo.

In one or two instances, the writer has attempted to ensile in a silo, rape and similar material in the long state. The experiments have not been successful, the resultant silage, as one of the farm hands described it, being of such a nature that a man could not go near it unless he was equipped with a gas mask. When chaffed with one of the modern chaff ensiling plants, very good results were obtained.

Some little difficulty, however, was experienced in passing the chaffed stuff through the blower, with which the chaff ensiling plant is equipped. This difficulty can be easily got over by chaffing at the same

time about one part of straw to every four or five parts of the green material. The straw absorbs some of the surplus moisture and prevents the blower from choking. There are very few farms, so far, equipped with a chaff ensiling plant, and a stave or common pit silo, and it would certainly be a decided advantage if some means were devised of ensiling rape and similar crops on the stack principle as described in an earlier chapter.

In the coming winter experiments of this nature are being undertaken by the writer and his farming partner.

NEED FOR SUBSIDIZED EXPERIMENT

In passing, the writer cannot help remarking that it is a pity that funds are not available by means of which farmers, who wish to undertake experiments similar to the above, could be guaranteed against loss. It is a very serious thing indeed to attempt the conversion of, say, 100 tons of green fodder into ensilage when the experiment proves a failure. Not only is so much valuable food material lost, but it throws one's feeding plans very much out of balance, and disorganises the whole business of the farm.

There is indeed much room for important research in connection with the whole subject of ensilage, and the educational authorities have certainly not given the matter one-tenth the attention which it deserves. In fact, glancing through the literature on the subject, it seems that all that has been done is to collect a certain amount of economic information from farmers who have, unaided, ventured upon ensilage experiments. Even then, in the instances referred to, the tendency seems to have been to devote far too much attention to the academic, or what the practical farmer terms "the finnicky points."

For instance, a tremendous amount of research work has been carried out to ascertain the chemical changes which take place in the actual process of converting the material into ensilage.

DRIFT OF RESEARCH WORK

This research, which is largely dwelt upon, is that a certain percentage of the albuminoids is converted into less valuable nitrogenous compounds, chiefly amides. Such knowledge is, of course, of some importance. But the big question after all, in connection with ensilage making, is not what is the slight loss sustained when albuminoids are converted into amides, but how much of the material, especially in bad weather, lacking the silage system, would be converted into muck.

Again, the main bulk of ensilage is usually made during bad weather, when it is generally impossible for man and horses to carry on other work. Lacking the ensilage system as a second string to his bow, a farmer would generally have his staff of men and horses idle. To repeat, in this, and many other respects, it is the labour economic question of ensilage which requires investigation.

SWAPPING EXPERIENCES

There are very great possibilities in connection with the conversion of such dense foliage crops as rape, kale, etc., into ensilage. Very often, in springtime, a farmer finds himself with more of these crops than will satisfy his immediate needs. His only remedy at present, is to buy in additional stock, but this is not always possible, and where possible, may not be profitable. Often, indeed, store cattle and sheep may

cost more per cwt. in April than they will bring later on in the season. Further, if the stock can be bought in and later sold out at a profit, there is considerable delay in consuming a large area of the crop and a consequent delay in getting down the succeeding crop.

This difficulty is the main reason why the old-fashioned system of catch-cropping was never adopted on anything like a large scale, except in sheep grazing areas. Many farmers who, for instance, put down, say, twenty acres of rye or rape as catch crops between corn and roots, found that the catch crops were of little or no advantage. One or two acres proved very useful as an early bite, but a large area of such plots generally meant the late sowing of roots and resultant poor crops.

With such crops as rye, vetches, or scarlet clover, when more of these crops are available than are wanted for immediate requirements, there is no difficulty in converting them into sweet ensilage, either on the silo principle, or on the writer's stack system, dealt with in an earlier chapter. Later, the results of a rape ensilage experiment, which the writer and his partner are about to carry out, will, when available, be put before the farming public. In return, it would be a great help to us, if any farmer who has already made experiments in ensiling such crops, would communicate with the writer. The more of this swapping of experiences which we practical farmers indulge in, the better for ourselves, for our industry, and for the future national welfare.

CHEAP TILLAGE

The cultivation, manuring, and seeding of rye have already been dealt with. As regards the cultivation of other types of winter greens, it is pretty much the

same in all cases. After a tare stubble cleared in the month of June, the land is cultivated as expeditiously as possible.

On light or medium land, ploughing is not necessary. The cultivation of such land can usually be done by the disc harrow and the triplex cultivator, without any ploughing at all. Deep cultivation, say more than five inches for these crops, is not essential.

The fact that the tilling of winter green crops can be accomplished with quick working tools is of the greatest practical and economic importance. Last year the writer ascertained that the cost of tilling and completely preparing a nine acre field for a crop of winter greens was only 13/6 per acre, horse and manual labour being charged at 3/- per day. This means that the complete cultivation of such a crop is no greater than the singling and weeding of a root crop, which these winter greens are intended, largely, to replace.

MANURING WINTER GREENS

We have already discussed the manuring of rye both as a cereal crop and when intended for folding, or for a soiling crop. The following remarks are applicable to all other types of winter greens—kales, rape, hardy green turnips, etc.

For these latter crops, which may have to stand over the winter, there is no manure so valuable as farmyard manure, because of its physical effects on the soil, and its fertilising qualities. Furthermore, once a Continuous Cropping rotation has been established, the application of farmyard manure in June, July and August generally fits in with the general work on a farm.

The writer's plan on such farms, where any carting of farmyard manure is undertaken (on one or two farms no carting of either crops or farmyard manure is undertaken, everything being consumed where grown), is this: The dung is usually carted out as opportunity offers on to the headlands of the fields where it is intended to sow the winter greens. This considerably expedites the work of carting and spreading the manure.

There are conditions, however, where to cart the manure on to an oat stubble, before sowing the vetches (this latter crop, in most rotations, will precede winter greens), better fits in with the general arrangements. Again, conditions may be such that farmyard manure might be applied as a top-dressing on the vetches during the winter, say in frosty weather.

This matter of fitting in the work, especially such heavy work as manure carting and spreading, is really a matter of individual judgment, and the general art of fitting in or dovetailing the work is the nucleus of all successful farming. Yet how very few farm stewards possess this art to any great extent.

Nevertheless, if a preceding crop of vetches have been grown with artificial manures, the winter greens should receive a liberal dressing of farmyard manure, from 20 to 25 tons per statute acre. Along with this, especially in dry seasons, or on poor land, from 1 to 1½ cwt. of nitrate of soda or sulphate of ammonia per statute acre, should be applied immediately the seed has been sown. The object of giving artificial manures is to push on the crop in its early stages of growth. A good start with a winter green crop is one of the main requisites for success.

L

When a liberal dressing of dung has been given to the tare crop, artificials will suffice for the winter greens. A suitable dressing would be from 4 to 6 cwt. of superphosphates, 1 to 1½ cwt. of nitrate of soda, and 1 to 1½ cwt. of sulphate of ammonia per statute acre. The minimum quantities should be applied to land in fairly good condition, and the maximum to very poor land.

USE OF ARTIFICIALS

On light soils, bone meal may be substituted for the superphosphate, and on peaty soils, or on heavy land, especially where there is a deficiency of lime, an equal weight of good quality basic slag may be used instead of superphosphate. Of course, basic slag must not be used in any mixture of manure which contains sulphate of ammonia. All the other manures may be mixed together and applied as soon as mixed.

Manuring a crop of winter greens in the above liberal manner will mean that the succeeding crop of potatoes or roots, assuming that the winter greens are consumed on the land, will not require any manure. If the winter greens are carted off, of course, the land is reduced in fertility, and further manuring will be required for the succeeding crop of roots or potatoes.

If corn follows the winter greens, whether the latter be consumed on the land or carted off, the land will generally be sufficiently fertilised to grow a good crop of corn.

SOWING WINTER GREENS

The seed of winter greens should only be covered in very lightly. After a fine tilth has been made, the

land should be rolled, the seed broadcasted, and then the land run over with a light seed or chain harrow. This latter operation is a dual one, covering the seed, and at the same time roughening the surface of the soil, which minimises the evaporation of moisture.

It is very important to sow the seed of winter greens very evenly and, above all, thinly. If sown too thick the crops come up very crowded with a weak, " spindley growth " which is unable to withstand even a mild frost. The quantities of seed for the different crops are as follows:—

Marrow stem,—thousand-headed and other forms of Kale—5 to 6 lbs. per statute acre.

Giant Rape—4 to 5 lbs. per statute acre.

Hardy Green Turnips—4 to 5 lbs. per statute acre.

Giant Essex Rye and Rape mixed—8 to 9 stone Rye, 2 to 3 lbs. Rape per statute acre.

Italian Rye Grass, Rape and Kale mixed for Rape Pasture—2 to 2½ stone Italian Rye Grass, 2 lbs. Rape, 1 lb. of thousand-headed Kale.

Where it is desirable to sow a mixed crop of winter greens, the same weight of seed per statute acre should be sown as indicated in the table above—that is to say, 3 lbs. of giant rape can be mixed with 2 or 3 lbs. of kale for a mixed kale and rape crop, or giant rape and hardy green turnips may be mixed together in equal parts of from 2 to 2½ lbs. of each kind of seed per acre.

If very dry weather obtains at the time that the land is ready for seeding, the sowing should be

delayed. If sown too soon, and the drought continues, the crop becomes either affected with mildew or the growth becomes stunted in its early stage, and never makes a full crop.

Another feature of dry farming methods of importance in a very dry season is this. After a prolonged spell of dry weather, on the appearance of rain, the land should be harrowed whilst the rain is actually falling, instead of immediately sowing the seed. The harrowing should cease, of course, as soon as the land shows any signs of becoming pasty. Then, whilst the soil is damp, the seed should be sown. If the rain continues, there is scarcely any further need of harrowing to cover in the seed. The rain will wash it in, but as soon as the land is fit and to give the seedlings a firm hold of the soil, the land might be rolled.

DRILLING WINTER GREEN CROPS

The slow-growing crops, and if necessary the quick-growing crops of winter greens, can be sown in rows. Where this is desirable, the seed may be sown with an ordinary drill or turnip sower, but a better way is to broadcast the crop, and when it is in the rough leaf, the cultivator can be run through, thus leaving the crop in rows.

By this method of sowing the farmer has an alternative. If the crop grows well at the beginning there will be no necessity for putting it into rows, as the crop will effectively choke the weeds.

CHAPTER XV

GROWING ROOTS AND POTATOES

If roots are to be grown in the rotation the best time to introduce the crop will generally be after winter greens consumed during winter and spring. Roots grown on the ordinary system, that is, on a stubble land left idle through the winter, are far from a profitable crop, but grown in connection with a Continuous Cropping rotation, the cost of root production can be very much decreased.

In the first place, the roots, having been preceded by two smothering crops, tares and winter greens, will be raised on clean land. Hence less hand and horse hoeing for the purpose of exterminating weeds will be necessary. In addition, the fact of having grown a dense foliage crop through the winter will result in the soil being far drier in spring-time and far more friable, thus enabling the preparation of the root land to be preceded with, even in a wet spring. Again, a further labour economy is possible by consuming the winter green crops *in situ*.

Where this is done with potatoes and turnips, the writer applies no dung. Artificials only are used on these crops, and consumption on the land of the preceding winter green crop is sufficient along with artificials to grow these crops without any further application of dung. Mangels, however, are gross feeders, and will generally pay for an additional application of manure.

The matter of the drying effect of a winter green crop is of great importance, and serves as another example of a very simple scientific fact being turned to the greatest practical use.

A LITTLE ELEMENTARY BOTANY

The leaves of the plant are the lungs of the plant, and perform functions in a plant similar to those which the lungs perform in a human being or other animal. One of the chief operations of the lungs in a human being is the expulsion of moisture from the system. If one breathes for a few seconds on to a pane of glass, the glass becomes immediately damp. Precisely the same effect may be obtained by placing a cabbage under a glass globe for a few minutes in the sunshine.

A plant really obtains its nourishment from the soil by absorbing through its roots plant food dissolved in the soil water. The moisture is expelled through the breathing pores of the tissues, leaving behind the plant food for the building up of vegetable tissue.

Now, it has been found that for every pound of dry matter in a plant, 250 lbs. of water are expelled by the leaves. In rape, for instance, there is 14% of dry matter. Hence, even in a 25-ton crop per statute acre there will be 3½ tons of dry matter.

Since 250 parts of water are required for the elaboration of one part of dry matter, it follows that for the production of 3½ tons of dry matter 875 tons of water are required.

One inch of rainfall per acre is practically equal to 100 tons of water. Therefore, by growing during the winter half-year 25 tons of rape *we rid the land by leaf evaporation of nearly 9 inches of rainfall.*

The root action of the winter greens also facilitates drainage, and between this and leaf evaporation one would be safe in saying that by cropping a field with winter greens we rid the land of about the equivalent of 12 inches of rainfall.

It is scarcely necessary to point out, further, how ridding the land, prior to the spring tillage operations, of this amount of moisture facilitates soil cultivation and crop-saving in a wet spring.

DRYING EFFECTS OF WINTER CROPS

So marked is this drying effect of winter crops that in the districts of low rainfall, if the crop is not consumed by the end of March, the land is so dry that the tilling may have to be delayed. This is a matter which requires individual attention on the part of each farmer, and a study of the average monthly rainfall in his district will be a great help.

One would imagine that this drying effect might mitigate against the success of the succeeding summer crops. Such, however, is not the case if a little judgment be used. The root action of the winter crops breaks up the soil particles in a most marked manner; hence a finer tilth is procurable on the cropped as compared with the uncropped portion. In other words, quicker tillage is possible, and the repeated turnings over of the soil in a dry spring are avoided.

This helps to conserve soil moisture, as does also the finer tilth. The finer the soil particles the more retentive of moisture is the soil.

Whilst it is possible to greatly reduce the cost of production of roots in the manner indicated, under no circumstances would the writer recommend the

whole winter green break to be sown with roots. If this be done, assuming the area cropped to be considerable, the amount of hand labour for the thinning, gapping, and weeding of the crop is scarcely procurable. Further, the only reason why roots need be grown on a farm at all is merely for use as a stand-by during prolonged frost or snow, when winter greens cannot be used, or a sufficiency of vetch or other silage is not available.

This latter type of succulent crop can be grown in most circumstances far cheaper than roots, or, at least, than roots on a large scale. Even in Norfolk; the Norfolk feeders' *penchant* for " roots " notwithstanding.

To sum up, the writer would only recommend perhaps one-fourth of the winter green break being sown in roots, just sufficient for the farm staff to attend to in summer, in what, from other farming operations may be regarded as spare time. To be more explicit still, the area of roots grown should not be greater than the farm staff could attend to, say in the morning, during hay-time, when waiting for the dew to dry off, or on a dairy farm, the area should be such as the milkers could look after " in between times," that is, after milking in the morning, and attending to pigs and calves, and before milking in the evenings.

Potatoes always do extremely well after a winter green crop. The fine, friable nature of the soil and the manurial residue resulting from the preceding winter green crop appearing to suit the potato admirably.

As regards the kind of roots to plant, mangels are to be preferred to turnips. They do far better after winter greens, and, unlike turnips, being of the brassica tribe, they are not susceptible to "finger

and toe." Further, mangels lend themselves to more intensive cultivation, giving a far greater yield than turnips.

The cultivation for mangels should be deep and thorough. Plough the land well, then disc harrow, and otherwise cultivate and work it down fine. As a rule after winter greens, cross ploughing will not be necessary.

The portion of the break where the mangels are to be sown will, generally, be the last to be cleared of the winter green crop; hence quick cultivation is very necessary, especially in a dry spring. In this connection, a disc harrow along with a good cultivator would help a tremendous lot. So much so, that except on very heavy land, if the winter green stubble is tackled in damp weather (and it is generally easy enough to get damp weather in spring) ploughing will not be necessary.

DISCS AND CULTIVATORS

Where these two implements are available, two or three cuts, first with the cultivator, then with the disc harrow, in opposite directions, along with a final refining with a spring tooth harrow, are all that are needed.

Having got the land thoroughly fine, drills should be opened about 28 inches wide, and manure carted into them. Then the artificials should be spread on top of the farmyard manure, and the drills split so as to cover in the fertilisers.

If this stage can be reached, that is, the mangels got ready for sowing about the third week in April, the crop can be grown from seed and sown in the usual manner on the drills. In practice though, one is

more likely to get into the first or second week of May before the mangel break is ready for planting. Anticipating this, it is better to put in mangel plants rather than sow seed for the crop.

The plants should be grown in a frame, the seed being put down about the 1st of March. Then about a month later, or as soon as the young plants have become fairly strong, they should be hardened off by removing the top frame, only covering them up in the early stages of the hardening-up process at night-time.

The mangels are dibbled in exactly the same way as cabbage, but the greatest care should be taken with them, to see that the tap-root is straightened out when planting, for otherwise the plant will fail. The root should also be dipped in liquid manure.

As soon as the plants are in, unless the land is too wet, the drills should be rolled with an ordinary iron one-horse roller. This firms the land and presses the plants down in the manure.

Now, this method of transplanting mangels is very important. For three years running the writer has had an increased yield of 10 tons to the statute acre from mangel plants put down in the first and second weeks of May, compared with the quantity obtained from seed sown at the same time.

MANGEL-PLANTING

Many farmers would imagine that mangel-planting is not likely to be successful. They base their opinion on the fact that often in thinning out mangels, and where they have come across a gap, they have transplanted a mangel and it has either died off or made very little growth. It is quite easy to under-

stand why such should be the case. A mangel plant put down at thinning out time, say, the end of May or early June, seldom gets sufficient moisture at that time of the year. Further, it should be remembered that the plant is put down between two other mangels, each of which has already got a hold of the ground, and in consequence, grows ahead, and smothers the transplanted mangel.

When, however, mangels are transplanted together they all have an equal chance, and, in addition, the transplanting process is done earlier in the year, and always during damp weather.

The writer has been so pleased with his success in connection with this new method of growing mangels that he now transplants nearly all he grows. By transplanting, the labour of thinning and hoeing later, generally during early hay harvest, is very much reduced.

It is necessary to give the mangels plenty of room, and on a 28-inch drill they should be left 15 inches apart. Another modification which the writer has adopted in mangel-growing is to sow every alternate drill with the long red and yellow globe varieties. This results in the mangels having more "breathing room." The "Long Reds," or Golden Tankards, grow upright, and the "Yellow Globes" nearer the ground. Experiments in this direction have shown that an increased yield of 5 tons to the acre can be obtained from mixed crops over and above that obtained from similar plots, each sown with one single variety. It should be mentioned, though, that the "Long Red" varieties when transplanted are apt to bolt.

So much, then, for the planting of the mangels. There are still, however, the questions of manuring and after-cultivation—the latter an all-important

point in the case of the mangel crop—and, finally, the lifting and storing of the roots, to be considered.

Since under my system the winter greens on the mangel portion will be consumed late in spring, they will be usually eaten on the land, but, in addition to the manure resulting from consuming the crop where grown, an additional 10 to 12 tons of dung per statute acre can be applied.

As regards artificials, mangels are very peculiar in their requirements. Having been produced or bred from a seaside weed, the mangel requires a good deal of salt. A good artificial mixture for mangels along with dung, consists of 4 to 6 cwt. of salt and 1 cwt. of nitrate of soda per statute acre.

LIQUID MANURING FOR MANGELS

Later on in the season liquid manure can also be given to the mangels. This should not be given in dry weather unless the liquid is very diluted, but it may be given in damp weather undiluted. A strong liquid manure applied during dry weather is liable to burn the plants. If liquid manure is not available, an additional cwt. of nitrate of soda should be applied at discretion when the plants have got a firm hold of the ground.

If it is not possible to give as much farmyard manure as the quantity mentioned above, the crop should receive an additional 4 cwt. of superphosphates per statute acre, as well as the quantities of salt and nitrate stated.

Sulphate of ammonia or nitrolin can be used in place of nitrate of soda, but the full 2 cwt. of both of these manures should be applied, mixed with the superphosphate and salt, on top of the farmyard manure, before the drills are closed.

Almost as important as the planting and manuring of mangels is their after-cultivation. There is no crop that pays so well for proper after-cultivation as does the mangel crop. The land after the winter greens will be clean, but, for all that, the crop should be hand-hoed twice, and a grubber run between the drills three or four times during the growing period.

By attention to these details, and assuming too great an area is not sown (that is, an area which the normal staff of the farm can look after), it is surprising what fine crops of mangels can be raised. Occasionally one reads in catalogues of extraordinary yields of mangels, but, on investigation, it will generally be found that the computation has been made by weighing a few yards of a drill, and estimating the yield per acre. For a long series of years the writer, by the method indicated, has had an average yield of nearly 50 tons per statute acre, every fourth load in carting from the field having been passed over the weigh-bridge, and 10% of the gross weight deducted to allow for adhering earth. This yield is more than double the average yield obtained.

AN AUXILIARY ROTATION

Latterly in connection with root-growing, the writer has found it a decided advantage not to include roots at all in the ordinary rotation, but to carry out what may be described as an auxiliary rotation on a piece of land in close proximity to the farmyard. Such a method of procedure shows to greatest advantage on a dairy-farm.

As a rule (there should be no exceptions) pork production is associated with dairy-farming, and where such is the case a field near the buildings can

be taken and divided into two sections, or two fields can be used for the purpose. On one section or field tares can be sown in autumn, and should be sown in rows and inter-cropped with winter greens.

By this means a supply of green forage for the folding of pigs will be available for eight or nine months in the year, and, as mentioned in my book on Tillage Dairy Farming,* pork can be produced by folding pigs on such a crop at less than one-half of what the cost was in pre-war times; where pigs are fed in the ordinary manner, owing to the higher price of meals due to the war, pig-feeding on this system is not more than one-fourth as costly as in the ordinary system.

The remaining section can be cropped with mangels, and after the mangels are lifted, tares inter-cropped with winter greens in the following summer can follow. That is to say, the rotation would consist of first year, tares plus winter greens; second year, mangels. The section which in one year is under the former crop, will in the second year be under mangels, and *vicé versâ*.

* C. Arthur Pearson, Ltd. Price 2/6.

CHAPTER XVI

THE INTER-CROPPING OF CONTINUOUS CROPS

One of the main objects of Continuous Cropping is the more even distribution of labour throughout the year. Instead of confining practically all the tillage operations and sowing of the crops to spring-time, from 60 to 80% of such labour in a Continuous Cropping rotation is carried out in summer and autumn.

When Continuous Cropping is carried out on an extensive scale, there is a danger that a farmer may find himself with too much labour on hand at times of the year other than spring, and especially in autumn. Such indeed has been the writer's own experience. To overcome this difficulty, the writer, has devised a system of inter-cropping, by means of which a more even distribution of labour is obtained, or, in other words, the amount of autumn labour is reduced, whilst of equal importance, the land, by inter-cropping, is never idle even for an hour.

When grass seeds are sown with a corn crop the one forms a " nurse crop " for the succeeding crop. In Continuous Cropping rotations, tares follow corn, and winter greens follow tares. By inter-cropping, the corn will act as a " nurse crop " for the tares, and the tares again will form a " nurse crop " for the winter greens.

HOW INTER-CROPPING IS DONE

It is not possible to sow tares as an inter-crop amongst corn, or winter greens amongst tares, when the respective " nurse crops," the tares and the corn, are grown in the ordinary manner. To carry out inter-cropping the " nurse crops " must be sown in rows at a greater distance apart than is usual. When both corn and tares are to be inter-cropped, it is necessary to sow the crop in rows at least 12" apart.

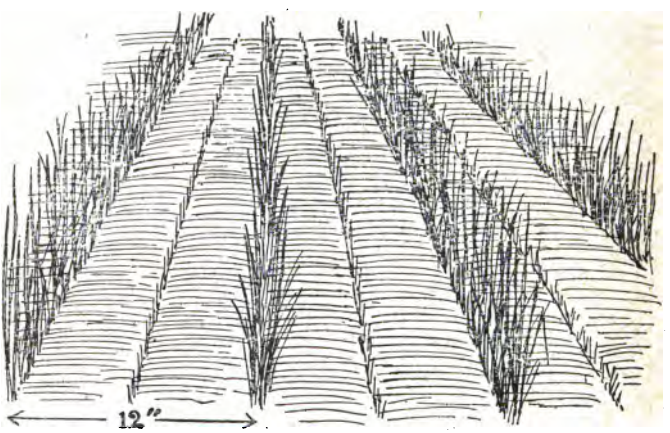


Diagram illustrating the Wibberley system of single row inter-cropping where the " nurse " crop (corn or tares) is sown in 12" rows, with the intercrop (tares, or winter greens) between the rows.

This is quite an easy thing to do, and is accomplished by sowing the crop with a corn drill, the feeding shoots or coulters of which are 6" apart. All that is required is to block every alternate shoot or coulter and proceed to drill in the ordinary way, care being taken to set the corn drill so as to sow the required amount of seed per acre.

For the purpose of sowing corn in this manner, or even for drilling in corn in the ordinary manner, there is no better implement than the disc drill, one of the finest inventions of the present age. Not only does this implement sow the seed and completely cover it in at the one operation, but in addition it materially helps in the preparation of the seed bed.

THE DISC DRILL THE BEST FOR THE PURPOSE

Disc drills are made in various widths from 5 to 8 ft., and the sowing coulters, or shoots, are fitted so as to sow in rows from 5 to 7 inches apart. For general purposes, the disc drill fitted with the coulters 6 or 6½ inches apart is the best.

With summer-sown corn, sown in rows about 12" apart, as mentioned in the chapter on corn-growing, it is necessary to graze down the crop before the advent of winter. Otherwise, if the crop has made anything of a luscious growth the frost will kill it. This grazing down will generally be done in late September and October.

After grazing down sometime during early winter, and whenever a favourable opportunity presents itself, the cultivator should be run between the rows of corn, the tines of the cultivator being arranged so that they run in the centre of the row of corn, and do not unduly disturb the roots of the growing crop. Sometimes it is possible to cultivate in this manner immediately after grazing. At other times the operation may have to be delayed until winter, or even until spring. Then about April or early May the crop may be grazed down a second time, or in a backward season growth may not be sufficiently advanced to admit of the second grazing down. However, a second cultivation should be carried out

in spring-time, preferably when the crop is about 6" high.

After cultivation, the whole crop can be chain harrowed and rolled, and when the crop is about a foot high the inter-crop may be sown. This latter point is very important. If the inter-crop in a corn crop is sown before the " nurse crop " is advanced in growth to the stage mentioned, there is a danger that the inter-crop may grow too vigorously and render the cutting of the corn crop very difficult to effect with a corn binder—that is, the butts of the sheaves may contain a portion of green material which prevents the corn passing easily through the binder canvasses, and also retard the drying of the sheaves when in the stooks.

If the corn has been allowed to get advanced in growth before the inter-crop is sown, then the former just permits the latter to get a root hold, but keeps its further growth in subjection, exactly as is the case when grass seeds are sown with a corn crop. In a moist growing season, the inter-crop, of necessity, will get advanced in growth by the time the corn is ready for harvesting. Under these conditions the corn must be cut with a high stubble.

Generally the type of inter-crop sown with a corn crop will be the mixture of tares previously given. After the corn has been removed the tares should be grazed down, and the grubber run between the rows of tares. This has the effect of rooting out the corn stubble, thereby forming a soil mulch and refreshing the tare crop, and so hastening growth.

In the following spring the second cultivation of the tare crop must be carried out in precisely the same manner as with the corn. In this case, the tares should be allowed, no matter how late the season, to get sufficiently advanced to allow of grazing down

before the second cultivation. Then when the tares have got about a foot high, the inter-crop of " winter greens " may be sown.

The tares may be cut for hay, ensilage, or soiling, and immediately after the tare crop is removed, inter-cultivation may be proceeded with between the rows of winter greens.

INTER-CROPPING CORN WITH WINTER GREENS

Where it is desirable to follow corn with any of the various types of winter greens—kales, giant rape, hardy green turnips, rye, etc.—the latter may be sown as an inter-crop with the corn crop. An instance of this is given in the case of the rotation mentioned earlier, where the intention is to sow two corn crops in two successive years, the winter green crop being consumed on the land before the sowing of the second corn crop.

With the exception of kales, winter green crops are comparatively rapid in growth when sown in summer. Therefore, it is especially necessary to allow the corn crop to get well advanced in growth—from 9" to 12" high—before the winter greens (with the exception of kales, which are best sown when the corn is from 6" to 9" high) are sown, otherwise the harvesting difficulties previously referred to may occur.

As to the actual sowing of the inter-crop, the disc seed drill, in the case of tares and rye, is the very best implement to use for this purpose. Kales are best sown with the little Planet Junior single row seeder, but they may also be sown with a grass seed harrow, fitted so that the seed apertures are a foot apart at an even distance between the rows of the " nurse crop."

On loose soil or easily-tilled land, especially of a peaty nature, kales, giant rape, etc., may be scattered broadcast over the " nurse crop," choosing showery weather for the purpose. When broadcasted, the resultant crop will not grow up in rows, but when the " nurse crop " is removed, it is a simple matter to run the cultivator with the tines set so as to leave the crop in rows.

The object of sowing in rows is to permit of the cleaning and consequent aeration of the soil. On loose soil aeration is scarcely necessary. As for cleaning, the winter green crop, because it is more vigorous on such land, will generally manage to smother weeds.

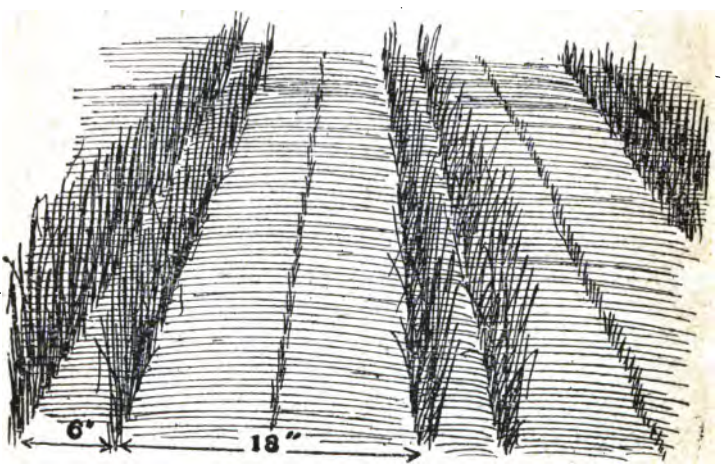


Diagram illustrating the Wibberley double row system of inter-cropping. More suitable for heavy land and dry districts than the single row system.

POINTS ABOUT INTER-CROPPING

There are one or two other points in connection with inter-cropping requiring attention.

In the first place, it is very necessary to keep in mind that land must either be in good heart or liberally manured in order to nourish the second crop.

In the case of corn inter-cropped with tares, the respective artificial dressings previously recommended should be used. That intended for the tare crop should be applied immediately after carting the corn, so as to promote the growth of the tare crop and give a good grazing sward for October. For the sheep farmer, grazing in the latter month is especially valuable to finish off backward lambs, hoggets, and culled ewes, whilst for the dairy and dry stock farmer, grazing in October, generally a hungry month, when pastures are finished and before it is too early to tie in stock, is equally valuable.

Where winter greens are sown as an inter-crop with tares or corn, the manurial dressing as previously recommended should be applied again immediately after the "nurse crop" has been removed. If, however, the intention is to give farmyard manure to this crop, from 1 to 2 cwt. of nitrogenous manure per acre, pending the application of dung, should be applied as soon as the "nurse crop" is removed.

On the general question of manuring, it is very necessary that the land should not be stinted when Continuous Cropping is being introduced. Especially is this the case in the initial stages. Later, as the stock-carrying capacity of the farm increases, more natural manure will be produced and concomitantly the expenditure on artificials reduced.

TILLING LEA LAND

Another matter requiring great attention is the more thorough tilling of the land for the lea oat crop.

Under the prevailing system the aim in many districts is to provide a solid seed bed, with only about 2″ of the top soil, "the cover," well tilled. This system will suffice for inter-cropping on the lightest soils, but on heavy land, if the undersoil is left pretty well undisturbed, the labour of cultivating between the rows of corn when the crop is above-ground will be all the greater. A firm seed bed for a corn crop is always necessary under any conditions, but there is no reason why the tilth cannot be both solid and thorough at the same time.

The writer attains this end by tilling the lea land on the following plan. First of all, the land is ploughed flat, that is to say, the furrows are turned completely over instead of being turned up on edge with a good arras or "feather," so dear to the old ploughman's heart. The object, as is well known, of this "arras" ploughing was to enable a good cover to be obtained when the seed was broadcasted. That is to say, the rectangular furrows, or trapezoidal type of furrows—the latter known to ploughmen as crushed box-shaped furrows—when set up on their edge, easily harrowed down to a seed bed. The seed was broadcasted before harrowing and fell into the seams between the furrows and grew up in rows.

There are, to-day even, many people who prefer this style of ploughing, and who advocate broadcasting instead of drilling. Life is much too short to argue with such people. This style of work was necessary before the digging plough, disc harrow, and the disc drill were invented, but with these implements, a seed bed, especially when the land is ploughed in summer and autumn, can be tilled very fine and still be firm. In fact, both implements are twice as effective when the land is ploughed flat than when the furrows are set up on their edge.

The latter is a point of importance in the case where motor tractors are used. It is much easier and quicker to plough land flat with a motor plough than to attempt to copy old-fashioned horse-ploughing with such an implement. After the land is ploughed the disc harrow is run once, and sometimes twice, in the same direction as the ploughing, then the land is cross disc-harrowed. After the latter operation, the spring tooth harrow follows, then the ordinary zig-zag harrow is run over the land—the first the same way the land has been ploughed, the second at right angles to the ploughing.

WHEN MOTOR TRACTORS ARE USED

In passing, it may be remarked that cross disc harrowing land, either with horses or with a motor, is not very satisfactory unless the land is ploughed flat. If the furrows are set up on edge, the discs have a tendency to run between the furrows and turn up the grass. After the final harrowing the seed is put in with the disc drill, and, after drilling, the land is again harrowed with the zig-zag harrow in the opposite direction to that in which the land has been drilled, after which the land is rolled if dry enough, and if not, the rolling is left until the crop is over-ground.

On heavy land with a summer or autumn-sown crop, the rolling is always left over until spring-time, as pre-winter rolling on such land is very apt to cake the surface.

The objection which many farmers have put forward in connection with inter-cropping, or rather, against sowing corn in rows 12″ instead of 6″ apart or less, is that the yield is likely to be less, when sown in wide, as compared with narrow rows. Such, however, so far, is not the writer's experience.

There is generally a greater yield of straw from the narrower drills, but *not as good a yield of grain.* Neither is the grain so well filled as when it is sown in wider rows. The eating down of the crop and subsequent cultivations promote root development and the general growth of the corn crop, whilst the greater circulation of air through the wider rows promotes ripening, and, more important still, minimises the risk of "lodging."

Some of the farmers referred to in support of their statement have invited the writer to inspect their crops. In these particular instances, he has found that, whilst the corn had a better head on the wider row portion as compared with that on the narrower rows, undoubtedly the yield of both straw and grain was lighter on the former, but in every single case it transpired that only half the quantity of seed had been sown on the wider rows!! That is to say, when sowing, the operator, in changing from the narrower to the wider rows, had merely blocked every alternate shoot, without so arranging the seed gauge that an extra quantity of seed should be sown by each individual shoot.

Drilling on twelve inch as compared with six inch rows, does not require as much seed in the former as in the latter case. Just exactly how much seed less is required is a matter which at present is under investigation. For the time being, the writer's general plan has been to reduce the usual quantity of seed only by about two or three stone per statute acre, when drilling in wide rows.

A MODIFIED METHOD OF WIDE DRILLING.

As may be gathered from the foregoing, the last word has not yet been said in connection with inter-

cropping, especially as regards the wide drilling of the tare and corn crops. One real difficulty which the writer has met with is, that on clayey land, especially in dry districts, and no matter how well the land may be tilled prior to sowing the nurse crop, the soil is apt to get hard. In this condition, the cultivator, unless fitted with a single narrow paw, which only scratches the soil, is very apt to tear up the top of the surface of the land in clods, and unduly expose the roots of the nurse crops. In other words a twelve inch row on such soils is too narrow for inter-cultivation in anything approaching an effective or satisfactory manner.

This difficulty, in most instances, can be overcome by a slight modification in the drilling of the crop. Instead of sowing from every alternate shoot of, say, a six inch corn drill, it is possible to block every alternate pair of shoots, that is, the first pair will be open, the second pair blocked, the third pair open, the fourth pair blocked, and so on. By this means there will be exactly the same number of rows of corn as though every alternate shoot was stopped, but between every two pairs of rows there will be a space of 18 inches instead of 12 inches. The former width is sufficient to permit of inter-cultivation and inter-cropping, the inter-crops being only sown in the wide alleys, that is, in the 18 inch space between every two pairs of rows of the nurse crop.

My experiments so far seem to indicate that 18 inches between the rows of corn is a little too wide, but if a drill is used with the coulters 5 inches apart, the " alleys " will then be only 15 inches, which is wide enough for inter-culivation.

As previously stated, the main object of inter-cropping is to relieve autumnal and summer work which would be necessary for the cultivation of oat

stubbles for tares and tare stubbles for winter greens. Just exactly what proportionate area of these crops should be inter-cropped is a matter of judgment for each individual farmer to determine.

LIMITATION OF INTER-CROPS

If too great an area is inter-cropped, the result most likely will be, too great a pressure of work, chiefly in early summer and late autumn, or at the time of the year when most of the inter-cultivation is undertaken. In most cases the writer finds that the nearest approach to the happy medium seems to be to inter-crop half the corn area and half the tare break, the remaining halves in each case being cultivated and sown after the respective crops have been harvested and garnered.

Inter-cropping is also of great use in the case of either spring sown tares or corn, especially so in late districts. With such crops and in such districts it is generally very difficult to get a large area of a corn or vetch stubble tilled in time to follow with another crop; but where spring-sown corn is sown so as to form a nurse crop for tares, or spring-sown tares is sown so as to admit of inter-cropping with winter greens, the inter crops can be sown so as to be established in the land, before either the corn or the tares are harvested.

Again, in the southern and eastern districts of England, or in low rainfall areas generally, it often happens that a corn stubble is so dry after harvest as not to permit of ploughing and cultivation with horse implements. Under such conditions inter-cropping is of special value, as the need for autumnal cultivation of the stubble is thus avoided.

Where a farmer is equipped with a motor and its complementary implements—motor plough, disc motor plough, motor disc harrow and cultivator—there is not the same need for inter-cropping when the latter is undertaken for the purpose of avoiding a high pressure of work after harvest. With such a plant, even where the land has become baked, the corn and tare stubbles can be rapidly cultivated and sown.

THE MOTOR AND INTER-CROPPING

The fact that the land is also dry facilitates the work of the motor. Land, however, may be so baked in autumn as not to permit of motor ploughing with the ordinary type of implement, but it is under such conditions that a well-made motor disc plough does its best work, ploughing the land or part cultivating it at one operation.

CHAPTER XVII

CONTINUOUS CROPPING ROTATIONS

As with ordinary rotations, there are several factors which must be taken into consideration when framing a Continuous Cropping rotation. These factors, generally speaking, are soil, labour, markets and climate. In the writer's opinion, the last named factor has not previously, in framing rotations, been much taken into consideration, but it should be the dominant factor. To a certain extent, it has been the dominant, not in causing the farmer to alter his tillage system, but in causing him to abandon tillage altogether, converting his arable land into pasture.

GRASS DAIRY-FARMING METHODS

Concomitant with this change, there has been another big change in the general system of farming, viz.: farmers have gone in more for stock keeping, in many districts, the stock being dairy cows for the production of milk, the demand for which, in recent years, has increased enormously. In fact, milk production or dairy farming in these countries at the present time is always associated with grass farming. Generally a small portion of the farm is devoted to tillage, a little corn being grown for home food and the straw for litter, roots also being grown for succulent food in winter. A portion of the land is also

meadowed with a view to providing winter food, but apart from the roots and hay, the main bulk of the food for the dairy cows in winter has been foreign food stuffs.

The amount of money which the average farmer spends on cakes and meals for dairy cows is simply appalling. It is quite a common thing to meet dairy farmers of, say 100 acres, whose cake bills in the year would be between £400 and £500. As the writer has often said in his lectures to dairy farmers, they pay one rent to the landlord and two or three rents to the cake merchant.

The main object of this liberal feeding is to increase the stock carrying capacity of the farm and, of course, the amount of milk produced. On this point there is not the slightest doubt that the farmer can obtain far better results, produce more milk, by converting a portion of his grass land into tillage crops, if the main idea of such tillage is the production of fodder and forage crops for subsequent conversion into milk.

Much has been said of the possibilities of tillage dairy farming as compared with pasture dairy farming. In recent years, the question which of the two systems is the more economical has been the subject of many debates and learned treatises by so-called agricultural authorities. With the exception of one or two authorities, which of the two systems is the more economical seems to be an open question. The writer has not the slightest hesitation in saying that the tillage dairy farm system is in every respect the better. No man who holds the contrary view can ever have seriously investigated the question, but must have formed his opinion from purely theoretical estimates and calculations, or else, his experience of tillage farming was based on the ordinary corn and root growing system of tillage.

To invite farmers to extend this latter system with a view to increasing milk production is to invite them to enter the bankruptcy court. The system is not sufficiently intensive, and the labour involved is not sufficiently divided throughout the year. Furthermore, the crops grown fail to provide a sufficiency of albuminous foods, without which a farmer, no matter how great the area of corn and roots he may have, is bound to buy albuminous cakes and meals in order to balance the home-grown food.

CAUSE OF HIGH MILK PRICES

The real cause of the present high price of milk is due to the dependency of the dairy farmer on foreign cakes and meals, and because of the high cost of the latter, on the average dairy farm, no greater profit is being made now than was obtained in pre-war times. As to the matter of markets in connection with a rotation, this is not anything like the important factor it used to be. In these quick transit days, we have less trouble shipping produce 200 or 300 miles than our forefathers had in taking it 10 or 20. To-day, so well organised are our transit facilities that the millhand of Bradford or Leeds may drink their early breakfast tea " coloured " with milk shipped over night from the neighbourhood of Belfast, or the fair resident of Mayfair may have cream on her afternoon tea table, which 36 hours before had not been drawn from the udder of a cow grazing in the golden vale of Limerick or on a Kerry hill.

POSSIBILITIES OF IRISH DAIRYING

Very fortunately, for the British farmer, his Irish contemporary has not yet realised the possibilities for

the sale of Irish produced whole milk and cream in the British market by still better organised transit facilities, and by the possibilities of increasing his milk output presented by adopting the Continuous Cropping system. In a pamphlet written by Sir Horace Plunkett, and published by the Irish Organisation Society, Sir Horace quotes the case of Menabela Bridge, a Co-operative Society in Co. Limerick:—"A mountainy district where the land was poor." There a body of farmers, at the writer's suggestion formed themselves into a co-operative implement society, and at the same time commenced to till a portion of their holdings on the Continuous Cropping system. The Secretary of the Society, in a letter to Sir Horace Plunkett, informed the latter "that in two years' time, by the adoption of the co-operative implement scheme and Continuous Cropping (Sir Horace Plunkett refers to the conjoint operations as "Wibberleyism") the farmers had increased their milk supply to the Menabela Creamery (which is also co-operative) from 188,000 to 317,000 gallons."

Sir Horace explains in his pamphlet:—"There was nothing specially favourable in the district to make one expect such a startling result, but there is in the result the happiest augury for the revolution in our agriculture which I am convinced needs nothing more than a reversion to the Recess Committee policy and an acceptance of the Department of Ireland's idea of rural reconstruction—a policy which has won the approval of statesmen, economists and social reformers throughout the English speaking world."

THE SAFETY OF GRASS

The reason (the fact will bear repetition) why so much land has been allowed to go down to grass,

especially in dairy districts, is because grass is a crop, which while conditions may retard its growth, such conditions never destroy the crop, and furthermore, the very wet weather conditions, which militate against the growing of ordinary tillage crops, causes the grass, the natural forage crop, to grow with greater luxuriance, and in recommending farmers to adopt a system of tillage dairy farming, the writer is really advocating a system of forage crop growing, the growth of which, like grass, is favoured by moist climate conditions.

It may be here mentioned, that when the writer first made his investigations on Continuous Cropping, some fourteen years ago, the chief idea was the growing of fodder and forage crops for conversion into animal products, chiefly milk. The whole subject of tillage dairy farming has since been dealt with by me in a separate book on the subject, a book primarily written for small farmers, but much of which is of equal importance to the large farmer. Space does not permit dealing with the subject in full in the present work, and for this reason we must content ourselves with a brief reference to the matter, chiefly as regards suitable dairy farm rotations.

CORN *v.* FODDER PRODUCTION

Before setting out rotations, it may be stated, that whilst for a few years at least, corn prices are likely to be high, and that, apart from prices, the needs of the nation demand as great an area of corn should be grown by every farmer as possible, yet, as soon as ever we are over our present corn shortage, a farmer whose land is situated in a heavy rainfall district would be well advised to adopt fodder and forage crop

tillage with just a sufficiency of corn for home requirements, instead of attempting to revive tillage on purely corn-growing lines.

This advice is equally applicable to the farmer who, living in such areas, cannot for various reasons carry out milk production. In such cases the fodder and forage crops grown can be economically converted into other animal products—beef, mutton and pork. Conversely, the farmer in lower rainfall areas would be well advised for a few years at least to devote his chief attention to cereal production, but at the same time producing his corn on a Continuous Cropping system.

A glance at the rainfall map given earlier will show that, with the exception of a few isolated areas, the rainfall in the United Kingdom increases from east to west. It is at its lowest, about 20 inches, on the south-east coast of England. Then along the whole east coast of Scotland, the middle of the east coast of Ireland, the eastern coast of England, along with a fairly large area in the Midlands, the rainfall is about 30 inches annually. Further west in each country it increases to 35 inches, and further west still it increases to 40 inches, 45 inches and even 50 inches annually. Again, with the exception of the south-west portion of England, the greater the annual rainfall the less the number of the hours of sunshine at the critical period for corn ripening, viz., July and August.

Of equal importance is the fact that, whilst no figures seem to be available on the point, the greater the annual rainfall and the lower the amount of sunshine, the more moist the atmosphere and the heavier the dews. Still further. Whilst the rainfall in these countries generally increases from east to west, the winter temperature increases from west to east. These factors plainly indicate the need for basing one's

tillage system on the study of the climate, the warmer moister areas being largely devoted to fodder and forage crop production and the opposite to cereal production, whilst in the area on the border line between the two extremes a combination of both cereal and fodder and forage crop production should be followed.

On the question of the winter temperature, a few figures sufficient to prove the statements given above, may be quoted:—

Average Winter Temperatures—degrees Fahr.

District.	Period Oct., Nov., Dec. deg.	Period Jan., Feb., Mar. deg.	Period Oct. to M'ch. inclusive. deg.
Ireland, N.E. ...	43.52	40.79	42.15
,, E. ...	44.53	41.3	42.91
,, S.E. ...	43.9	40.98	42.44
,, N.W. ...	46.8	41.68	44.24
,, S.W. ...	46.98	42.85	44.91
England E. ...	43.91	39.08	41.49
,, N.E. ...	43.21	38.96	41.14
,, N.W. ...	43.33	39.06	41.19
S.W. England & S. Wales ...	47.40	42.68	43.35
N. Wales, including Hoylake and Hawarden Bridge. ...	45.58	41.12	45.04

Further information may be obtained on this and other points (and it is necessary that the farmer should obtain full information on these points) by studying the official meteorological compilations.

We shall now proceed to study different rotations suitable for the different types of existing climatic conditions. As already indicated, we can classify different types of rotations under three heads:—

ROTATIONS BASED ON RAINFALLS

Class 1. Rotations designed for the production of fodder and forage for animal consumption.

Class 2. Rotations in which the production of animal food is combined with the growing of food for direct human consumption, e.g., cereals and potatoes.

Class 3. Rotations primarily intended for the production of human food for direct consumption.

Generally speaking, Class 1 rotations are recommended for areas with an annual rainfall of over 35 inches; Class 2 for areas with an annual rainfall of from, say, 28 inches to 35 inches; and Class 3, rotations for areas with less than 28 inches annual rainfall.

It must, however, be borne in mind that a 25 inch annual rainfall on heavy soils may retard tillage operations to a greater extent than on a lighter or easier worked soil. In other words, the farmer must regard the recommendations made as being of a general nature and the rotations are given merely to act as a guide.

WANTED—MORE RESEARCH

Possibly some day the recommendations which the writer has frequently made to the authorities will be carried out, viz., to obtain statistics with a view to ascertaining the average number of days throughout the year that climatic conditions permit of carrying

out tillage operations. No great expense would be necessary to conduct such an investigation. All that is required is the keeping of a dairy by a few farmers in each district, indicating the number of days on each farm on which wet soil conditions caused tillage operations to be suspended.

CLASS I. ROTATIONS

A TILLAGE DAIRY FARM ROTATION

The following may be described as a purely tillage dairy farm rotation, suitable for a small type of dairy farm where it is assumed that litter, either straw or peat moss, can be purchased:—

1st Year.—Winter tares for sectional grazing or soiling.

2nd Year.—Winter tares made into hay, followed by winter greens.

3rd Year.—Potatoes and roots.

4th Year.—Winter tares for hay, with which "seeds" are sown.

5th Year.—"Seeds" used for soiling.

Under such conditions where the purchase of litter is not possible, the rotation can be modified so as to have a crop of corn, either in the first or in the fourth year of the rotation, or better still the rotation can be extended over a six year's course, the winter tares in the fourth year being cut twice for soiling, hay making or ensilage, and in late September or October, a crop of corn, winter oats, or winter barley sown, with which "seeds" can be put down in the following spring. The method of sectional grazing and soiling has already been dealt with. Where tares are sown

for this purpose, in the first year the crop, as far as possible, should be consumed where grown, so as to economise labour in carting the crop and manuring the land. By consuming the crop *in situ* the humus contents of the soil will be increased, and the land will be in very good heart for the following crop of tare hay. The salient points of this rotation are as follows:—

1. Four leguminous crops are grown in the rotation, which enrich the soil in nitrogen.
2. A large amount of humus is ploughed into the land.
3. The amount of stock which can be carried is very high, being at least double the number the land would carry if grass dairying is followed.
4. Heavy stocking means heavy manuring and enhanced fertility of the soil.
5. The crops grown provide balanced rations without the use of imported foodstuffs.
6. Both horse and manual labour are evenly distributed throughout the season, and are comparatively cheap, considering the amount of arable land.
7. The land is practically never idle.

A DRY STOCK FARM ROTATION

Another rotation which is followed on a farm practically devoted to the production of beef and mutton is as follows:—

1st Year.—Winter tares cut for hay in June, followed by winter greens.
2nd Year.—Roots and potatoes.

3rd Year.—Half winter tares, sown in autumn, and half winter oats for horse feeding, with "seeds" sown in the following spring and grazed the following autumn.

4th Year.—"Seeds" mown once and then grazed.

Another rotation, where again the object is the production of food for animal consumption, is as follows:

Period and Crop.	Time Crop Occupies Land.	No. of Months.
1st period. Lea corn sown early autumn ..	August to July	12 months.
2nd period. Tares for hay and ensilage followed by winter greens.	August to June July to April	11 months. 10 months.
3rd period. Tares with seeds	May to August	4 months.
4th period. Seeds for hay 5th and 6th periods. Seeds for pasture.	September to next July but one.	23 months.
	Total ..	5 years.

CHEAP LABOUR ROTATION

This rotation is an admirable one for an outlying farm, or where fields are very remote from the farm buildings or for other reasons not easily accessible. Under the conditions mentioned, it serves as a very fine example of what great labour economies can be effected by consuming crops where grown, instead of carting the crops home and the manure back. This is accomplished by the assistance of moveable fences and

moveable sheds. The only crop, or rather part of a crop, which needs be carted, is the grain from the corn which can be threshed on the field. The straw, except a small portion to be used as litter for horses, can be used for either litter or food on the field where grown.

The types of fodder and forage crops grown under this rotation is specially suitable for feeding dry cattle, either stores or beef, along with a few sheep, or where it is not possible to keep sheep (if such conditions exist anywhere), young cattle, suckling or weaned calves, can be kept instead. The lea corn can be sown as already stated in the chapter on corn growing, in late summer or early autumn, say in early August. This means ploughing up the lea land in July, and this in turn necessitates a fair amount of summer moisture. The corn can be grazed with sheep in late autumn and early winter, and again, at least, after a mild winter, in early spring time.

Half the corn area can be sown in wide rows and inter-cropped with tares, the balance of the corn being sown at the ordinary distance, this half of the corn area being sown when the corn is removed. The inter-cropped tares can in turn be inter-cropped with "winter greens" and the other portion tilled, cultivated and sown with "winter greens" when the tares are removed. About half the area under tares should, if weather permits, be made into hay. If the weather is not suitable when the crop is ready for cutting, it can be made into ensilage.

Under any weather conditions half the tare crop area should be made into ensilage, which can be used during frosty and wet weather, when the "winter greens" are not available. As to the "winter greens," the crop, whenever weather conditions are suitable, can be consumed by cattle and sectional grazing resorted to during the winter. During wet

weather a portion of the " winter greens " can be carried to the moveable sheds, which, during the winter, when the " winter greens " occupy the land, will be erected in the same field.

As regards sectional grazing of " winter greens " in the manner indicated, many farmers imagine that by following out this recommendation, the land would become dreadfully poached. It is evident that they have overlooked the fact that the "winter greens," through the enormous amount of water which they expel from their leaves, help very materially in keeping the land dry. Further, it is not intended that the cattle should be constantly kept on the " winter greens." In practice, the cattle get one or two hours' grazing per day, say in the afternoon, when an overnight's frost would be cleared off the crop. If the weather turns out excessively wet or frost continues, then the cattle should be kept all day in the moveable sheds and ensilage used as a succulent food. Cattle will turn from " winter greens " to ensilage and vice-versa at very short notice without any ill-effects. The stack of ensilage and also the stacks of hay should, of course, be built in close proximity to the moveable shed.

AFTER " WINTER GREENS "

After the " winter greens " have been consumed, the land may be ploughed up and sown with tares, and a grass seed mixture as in the case of the corn crop being sown down with the tares. The type of seed mixture may also be varied. It may consist, chiefly, of rye grass and ordinary clover, or 10 to

12 lbs. of sainfoin may be used with the mixture. In every case a portion of scarlet clover *(trifolium incarnatun)* should be included in the mixture. Where land is suitable for lucerne, this admirable crop should be sown.

The tares grown in the third period of the rotation may also be made into hay or ensilage, but since the crop will not usually be ready for cutting until August in most districts—and it follows from what has been stated before that any rotation designed chiefly for the growing of fodder and forage crops for animal food is essentially a wet district rotation—the crop should be made into ensilage. The seed sown in the first year will, at the first cutting, be ready for June, a month during which it is not difficult to make hay.

An endeavour should be made to cut the seeds hay at the same time as a portion of the tares. The two crops blend very well together in stacking, and will, when so blended, make admirable feeding. The crop, when consumed with " winter greens " and ensilage, enables the farmer to turn out prime beef without the use of cakes.

In this particular rotation and others of a similar nature there is one point requiring close attention. In practice, farmyard manure may not be available for the crops sown during the first and second periods of the rotation. It follows that the crop grown during these periods must be very liberally manured with artificial manures until, at least, the general fertility of the land has been toned up. If this is not done the result will be very disappointing, but, whilst what the farmer may look upon an excessive expenditure on artificials is required for the crop under discussion, no further artificials will be required for the crops in the third, fourth, and fifth periods of the rotation, except on very poor land.

What tremendous possibilities there are in connection with Continuous Cropping on mountainy or hilly land! On such land, pasture, if one can by courtesy use such a term in speaking of these mountain stretches, holds sway. Tillage on these mountainy lands on the old plan is entirely out of the question. Such tillage means an impossible amount of work in carting the crops home and manure back. It means a big rush of work in spring for cultivation and a big rush in autumn for harvesting. These difficulties have proved to be too great even for the lowland farmer, hence the tremendous decrease in the tillage area for the last generation or so.

A MOUNTAIN FARM ROTATION

Again. Bad as climate difficulties may be for the lowland farmer they are infinitely greater for the mountain man. A study of any rainfall chart will show that whilst there may be an annual rainfall of 30 inches in the lowlands, the annual rainfall in a neighbouring hill district only a few miles distant may be 50 inches or even higher. Apart from the rainfall, as previously stated, the crop and manure carting involved in the ordinary system of tillage makes the system on a mountain farm prohibitive. Between bad roads, or the entire lack of roads, and steep inclines, a horse cannot haul half an ordinary load either up or down the hill.

DO AWAY WITH CARTING

In laying out a suitable rotation for the tilling of hilly land it is therefore imperative to dispense, as far as possible, with carting; to grow crops which will

not be at the mercy of the elements—crops also, the culture and sowing of which can be undertaken at a time of the year when rain does not hang up the whole of the tillage work, but instead helps on tillage operations. On hilly land where, as often happens, there are wide stretches of fairly level land, the previous rotation mentioned will be found very suitable, but in the absence of these small plateaux, or where rainfall is very high, a far better mountain farm rotation would be as follows:—

1st Year.—Summer sown rye crop to provide winter pasture.

2nd Year.—Summer sown " winter greens."

3rd Year.—Spring sown vetches and grass seeds made into hay in July, the aftermath grazed in autumn.

4th and 5th Years.—Grass seeds with rape for grazing. (Rape Pasture.*)

In this rotation, the object aimed at is to dispense with, as far as possible, the necessity of harvesting any of the crops. The only crop harvested are vetches sown in the third year and, if necessary, the first cutting of the seeds hay in the 4th year may also be harvested. One of the crops or a portion of each should be made into ensilage as a standby during bad weather, say a snow storm, when green food, although existing in plenty, cannot be consumed. The rest of the harvest will be done by the grazing animals, and the best type of grazing animal for this type of farm and the system of cropping is, of course, the sheep. All the green crops are consumed where grown, the sheep being folded on them.

* See " Continuous Cropping and Tillage Dairy Farming for Small Farmers " for details. Pearson's. Price 2/6 net.

SOME TIPS ON FOLDING

The folding, though, must not be close. That is to say, instead of confining, as is done in some districts, from 60 to 100 sheep on half an acre of land, three or four acre folds should be used for such a number of grazing sheep. By the exercise of a little ingenuity a fresh supply of green food can at all times be made available (except, of course, during a snow storm). Also by tilling on the lines suggested, the stock carrying capacity of a great part of the hilly or mountainy land can be trebled. Again. Not only can the number of animals per acre be increased, but a far better type of sheep can be kept. This remark, as is equally true of the general statements made in this book, for it is not mere theory but a simple record of what the author himself has accomplished.

By introducing a tillage system of cropping to provide green food throughout the year, it is possible to keep on such hilly land as we are describing, very well-bred Leicester and Roscommon ewes, which, crossed with either a Shropshire or Leicester ram, produce lambs double the value of the mountain breeds which under existing conditions are the only breeds which can survive on the scanty fare.

WHAT THE ROTATION DOES

Study the rotation in detail and it will be seen that the only crop sown in spring time is vetches, which require the minimum of cultivation. There is no manure carting; there is very little crop carting; and whilst the moving of folds and the erection of shelter

sheds entail a certain amount of labour, this labour is very evenly distributed throughout the year, and is of such a nature that it can be undertaken by the shepherds and his assistants during their spare time. One is familiar with the great improvement which has been made in mountain pasture by the application of slag, but such improvement compared with that which can be effected by Continuous Cropping tillage bears about as much relationship as does the light of a tallow candle to an electric light.

It should also be noted that in this rotation, as compared with the preceding one, that before the "winter greens" are sown, a crop of summer rye has been consumed on the land. This means that, prior to putting down the former crop, the land has been enriched physically and chemically because of the addition of humus, resulting from the growing and consumption of the preceding crop. Again, it is necessary to emphasise the importance of being very liberal with artificial manures in the first one or two years of the rotation.

Although we speak of the preceding rotation as a mountain farm rotation, yet it is equally suitable for carrying out on lowland farms where climatic and soil conditions are suitable.

CHAPTER XVIII

ROTATIONS TO PRODUCE ANIMAL AND HUMAN FOOD

We will now proceed to discuss the second type of rotations, where the object aimed at is the production of animal along with a certain portion of human food. A typical rotation of this nature is as follows:—

1st Year.—Potatoes on the lea.

2nd Year.—Autumn sown rye after potatoes followed by " winter greens."

3rd Year.—Spring sown cereals.

4th Year.—Autumn sown tares with seeds, the latter sown in spring.

5th Year.—Seeds grazed in previous autumn, cut for hay and aftermath grazed again.

This rotation also provides for an even distribution of labour throughout the year.

As regards the growing of potatoes on the lea, anyone familiar with potato growing is well aware that lea potatoes can always be depended upon to give a magnificent crop of tubers of the finest quality. Until quite recently, however, considerable difficulty was experienced in tilling lea land for potatoes. The introduction of the disc harrow though, has solved this difficulty. It is as easy to till even very old lea for a drill crop with a good implement of this kind, as to till stubble land without it.

The lea land, before ploughing, should be disc harrowed in opposite directions so as to cut the turf

THREE POTATO DRILLS AT A TIME.

Farming on Factory lines means using up-to-date machinery. Opening out three potato drills at a time on a rape stubble with a small Saunderson Motor and a Martin's Cultivator.

into squares. This is an operation (and the point is of great importance) which can be carried out in winter and in wet weather. In fact, short of the land being actually saturated, the wetter the lea land, the easier it is to work the disc harrow on it. Cutting up the turves in this manner will cause the soil to rot. After the above operation the land should be ploughed and the old turves turned under—another operation which can be carried out in wet weather.

In the following spring the land should be disc harrowed with an overlap stroke in the same direction it has been ploughed. Then the spring-tooth harrow follows, and then the land is cross-disced, again with an overlap stroke. A further run with the spring-tooth harrow and the drills may be opened. On very stiff land it may be necessary, before the final spring-tooth harrowing, to run the cultivator through the land and break up more of the under soil than the disc would have been able to reach.

Cultivating in this manner to a person not familiar with the system, the potato land may have a very soddy or rough appearance, but there is no harm in this as the turves or sods help in the development of the tubers by keeping the soil loose. Where the writer carries out this rotation there are about 20 acres in each break. On the potato break, 5 acres are sown with earlies, 5 with second earlies, and 10 acres with a late variety, the point aimed at again being an even distribution of labour. Immediately each section of potatoes is lifted the rye is broadcasted and simply covered in with the harrow.

The rye, sown after the first and second earlies, gives very fine feeding in October and again in the following April and May, by which time, that sown after the late potatoes is also ready for feeding. In April and May cattle, as well as sheep, may be allowed

to graze the rye, or it may be fed off by these animals by the assistance of a moveable fence. As the grazing or soiling of the different sections proceeds, the rye, stubble is ripped up, and sown with different types of "winter greens," the early sown portion with kales, then follows a section of giant rape, and the last section sown is put down under hardy greens.

MORE WET WEATHER TILLAGE

The cultivation and sowing of these crops, again let it be particularly noted, is done during wet summer weather when hay making is suspended, and when, lacking such work, horses and men might otherwise be idle.

The "winter greens" provide food from September to the end of March or mid-April. The "winter greens" grazed in September and early October yield a second crop in spring. This second crop is usually grazed by ewes, with lambs, in spring for which purpose it answers admirably.

In spring, as the different sections are cleared the cereals are sown, generally black Tartary oats, which are a quick ripening variety, and therefore stand late sowing, and may even be sown up to the middle of May. The tares intended for hay in the fourth year may either be put down after the cereals or may be inter-cropped with the cereals or part may be inter-cropped and part sown when the cereal crop is removed.

As will be seen, in a five years' rotations, two crops, mainly for human food, are grown—a crop of potatoes and a crop of grain. Everything else, as well as the straw from the cereals, is consumed on the farm.

Another rotation of the type under discussion, in which a greater proportion of corn is raised than in the foregoing, is as follows:—

1st Year.—Corn inter-cropped with "winter greens."
2nd Year.—Potatoes.
3rd Year.—Corn inter-cropped or followed with autumn sown tares.
4th Year.—Tares, either hayed or ensiled, and "winter greens."
5th Year.—Spring corn and seeds.
6th Year.—Seeds hay, aftermath ensiled or hayed.
7th Year.—Seeds grazed.

REDUCING THE RISKS

The outstanding features of this rotation are that whilst a considerable area is given to corn production, the cultivation of three corn crops are carried out at three different times in the year. Again, the harvesting of the corn crop will take place at three different times of the year, which not only means a more equitable distribution of labour but a diminution of harvest risks.

This latter feature can best be described in the words of an Irish farming friend. He had adopted the system, and spoke of having his corn harvest "divided into three halves"!!

As distinct from the production of corn on the ordinary lines, the humus and vegetable contents of the soil are maintained by the growing of such a large amount of winter greens and tares, which can either be ploughed in for green manure or, in the writer's opinion, more economically used by grazing first with sheep, and the resultant residue then turned under.

In addition to corn, there is one break, also under potatoes for more human food, but in districts where the soil is not very suited for potato production, or where it is desirable to provide succulent food for horned stock during winter, the area under potatoes may be reduced or entirely eliminated, and roots (mangels for preference because of their immunity from finger and toe) grown instead.

These, along with tare hay, would enable cattle to be fattened in the winter, or could be used for food for winter milk production. The weak spot of the rotation is that there would scarcely be a sufficiency of albuminous foods to enable a farmer to make balanced rations with his straw, necessary for beef.

Another rotation of the type under discussion, and which is very suitable where the object is a combination of animal husbandry and corn production, is as follows:—

1st Year.—Summer sown corn inter-cropped with "winter greens."
2nd Year.—Spring sown tares cut twice for ensilage.
3rd Year.—Autumn sown corn inter-cropped or followed with autumn sown tares.
4th Year.—Tares hay and inter-cropped or followed with "winter greens."
5th Year.—Spring corn and seeds.
6th Year.—Seeds hay, aftermath ensiled.
7th Year.—Seeds grazed.

GREEN MANURING

Again, it is assumed that whilst the main bulk of the grain is sold off the farm, the straw will be fed to animals. Straw, of all types of food, has a very low

albuminous ratio, and in order to make its consumption economical, it is necessary to feed straw along with highly albuminous foods. Under ordinary systems of farming, cake and meals, mostly of foreign origin, are used for this purpose; but in the above rotation, it will be noticed, a large bulk of home-grown albuminous food, vetch hay, vetch silage, seeds hay and ensilage, as well as " winter greens," is provided. Again. The " winter greens " are grown twice in the rotation and by their consumption on the land, preferably with sheep, the humus and vegetable contents of the soil are maintained.

This indeed, in corn growing areas, is a matter of vital importance. Too often in corn raising areas the humus contents of the soil are very deficient, the land in consequence having a heavy nature, becomes sad and difficult to till, whilst if the soil be light, the exhaustion of its humus contents results in the land becoming what the farmer terms weak—that is, unretentive of heat, moisture and plant food. The chemical fertility of such land may be maintained by the liberal use of artificial manures, but there is nothing which will keep up the physical fertility, except the application of natural manure or vegetable matter.

Indeed, the humus contents of soil in many corn growing districts have become so depleted that it would be better, for a few years at least, to turn in the " winter greens " as green manure. Once the physical nature of the soil has been improved sufficiently by turning in green manure, it would be more economical to consume the winter green crops, preferably by sheep, and plough in the residue.

In fact, the above rotation is probably as fine an example of animal husbandry combined with human food production as can be given. Furthermore, it per-

mits of mixed animal industry, that is to say, the crops grown will allow of milk, beef and mutton production, and just as it is generally wise to vary as much as possible the varieties of crops grown, it is equally wise to keep a variety of live stock.

This rotation is intended for a district where the annual rainfall is from 28 to 35 inches. Even where the rainfall is less than 28 inches and the soil is of a fairly heavy nature, this rotation will be found very useful. On medium or lighter soils with a rainfall of less than 28 inches, more attention should be given to human food production, but it is not practicable, except in very exceptional cases indeed, to carry out the cropping of a farm solely for direct human food consumption. As is indicated above, the physical contents of the soil must be maintained, and this is only possible, either by green manuring or by combining animal husbandry with human food production.

LOW RAINFALL ROTATIONS

The lower the annual rainfall, the greater the amount of sunshine, the less the difficulty experienced in the sowing and harvesting of the crops intended for human consumption. It is for this reason the writer holds the view that the eastern parts of these countries generally and particularly the south-eastern parts, are better suited for corn production than the remaining areas.

There is, however, no reason why the cultivation of corn and other food intended for human consumption —beans, peas and potatoes—should not be carried out on a far more intensive system than usually obtains in the districts referred to. This is possible by the adoption of Continuous Cropping rotations. An example of such a rotation is here given.

1st Year.—Late summer cereals, followed with forage crops, e.g., tares, rye, rye grass.
2nd Year.—Forage crops sown autumn first year, folded off, followed by summer sown " winter greens."
3rd Year.—Spring sown cereals, followed by scarlet clover.
4th Year.—Scarlet clover grazed in spring and early summer, followed by " winter greens."
5th Year.—Potatoes.
6th Year.—Winter sown corn with seeds.
7th Year.—Seeds.

It will be noted that in the seven years of the rotation, three corn crops and a potato crop, all intended for direct sale, are grown. Also that with the exception of the fifth year, during which manure will be applied direct to the potatoes and roots, a forage crop will be consumed on the land, which will have the treble effect of maintaining the humus of the soil, preventing the loss of fertilising elements from being washed out during the winter and increasing the nitrogen contents of the soil, all important factors in successful cereal production.

Further. The labour of man, horses and machinery is very evenly distributed throughout the season. The only crops to be put down in spring time, usually the wet period, will leave the land in a far drier and friable condition than if the soil had been unoccupied through the winter. By varying the type of the forage crops sown in the autumn of the first and third years, the labour involved in the growing and consumption of these crops and the subsequent cultivation can also be distributed. For instance, the first year's cereal stubble can be divided into three sections:—

Section 1.—Wheat sown in 12 inch rows and intercropped with rye.

Section 2.—Sown with Italian rye grass and a little red clover as a nurse crop; corn and seeds sown in the ordinary manner.

Section 3.—Corn sown ordinary manner and the stubble ploughed up and cultivated after the harvest and sown with mixed tares.

In the following spring the rye would be first ready for grazing and could be folded off with sheep. The rye grass would follow next and then the tares. As each section was folded off, cultivation for the subsequent crops could be undertaken, the ploughing following on the heels of the sheep, and so on with each of the remaining sections.

By careful management, the " winter greens " sown after the first plot of rye, which is consumed, would be ready for folding by the time the last strip of the tares was finished, and by the time the first section of " winter greens " was ready, the second sown section would be ready for folding, and so on. The early folded sections would again give feeding in the following spring, and could be eaten off in plenty of time for the sowing of the spring corn.

Each of the sections would, in their respective order, be cultivated and sown during the months of May, June, and July. In like manner, the scarlet clover or trifolium sown on the third year's corn stubble could be varied by dividing the stubble again into three sections and sowing each section with the early, medium, and late varieties of this forage crop.

As to the type of "winter greens" suitable for sowing at the different times, general information under this head can be obtained from the chapter on this subject, but in this as in many other respects, it is for each individual farmer to ascertain by trial what particular type or types will give the most satisfactory results.

CONSUMPTION OF CROPS

There will be a large amount of straw to be disposed of and for the economical consumption of this, at least roots will be necessary, and where store cattle can be kept, albuminous foods, cakes and meals, if the intention is to carry out any fattening. Where such a large amount of food is sold off the farm, it may be allowable to purchase feeding stuffs for cattle feeding, but where this is not done, it is clearly indicated that the class of stock to be kept will consist of sheep and store cattle.

The seeds hay grown in the seventh year, can be used for feeding horses and a certain portion reserved for the sheep in the winter. As to the quantity needed for this latter purpose, it will depend upon the style of sheep farming. Sheep come into the category of moveable stock, and are easily purchased and sold off at any time of the year. If a large number of sheep are to be wintered, probably more hay will be required than is provided for in the rotation, but some land can be reserved, that is as permanent meadow.

AN ULSTER ROTATION

We shall conclude this chapter by setting down a rotation already in existence and carried out over a large area in Ulster, and what may be called a modified Ulster rotation, which the writer carries out on two farms in that Province. Before doing so, a few facts in connection with the climatic conditions which obtain will be of use, insomuch as they will enable the reader to make comparisons between one system of cropping and another, and also comparisons between the climatic conditions obtaining in Ulster and those existing in the particular locality where the reader is situated.

The annual rainfall in Ulster varies from about 32 inches to 49 inches, the spring rainfall being as follows:—

February	2.36 inches
March	2.45 ,,
April	2.74 ,,
Total	7.55 ,,
Average per spring month ...	2.51 ,,

The Ulster August rainfall, by custom referred to as the harvest month—although often corn is not cut until September—is 3.64 inches, there being an average of *19.8 rain days in this particular month.* Another matter of importance from the Continuous Cropping standpoint is the average winter temperature. For the period, October, November and December, the average winter temperature in Ulster is 43.52 degrees Fahr. For the three months, January, February and March, the average temperature is 40.79 degrees Fahr., the average for the whole six months referred to being 42.15 degrees Fahr.

	An Ulster Rotation.	A Continuous Cropping Ulster Rotation.
1st Year	lea oats spring sown	Lea corn summer sown.
2nd ,,	flax	Vetches and winter greens, autumn and summer sown respectively.
3rd ,,	potatoes and roots spring sown.	Flax and potatoes, spring sown.
4th ,,	Corn, spring sown	Corn, autumn sown.
5th ,,	Grass for hay ..	Grass for hay.
5th ,,	Grass for pasture ..	Grass for pasture.

The figures given serve to furnish, in a very effective manner, the difficulties of carrying out the ordinary Ulster rotation, since of the tillage crops in this rotation all are sown in the spring time, when due to heavy rainfall, more often than not, for the one dry day, on which men and horses work on the land, there are usually three or four when it is impossible to do so.

Again, the saving of the two corn crops is crushed into a few days at the end of August, and a few days' wet weather at harvest time means lodged crops and often destroyed crops.

HURRYING UP THE HARVEST

The corn sown under the improved rotation ripens in both cases much earlier than the spring sown corn. The earlier the corn is ripe the less chance there is of it lodging; the greater the amount of sunshine, the lighter the dews, both during, and of still greater importance, before corn cutting commences. In the ordinary rotation, the land is idle for a period of from six to eight months between every tillage crop. Under the improved rotation *the land is never idle.*

Flax is a very important crop from the Ulster standpoint, and for the growth of the crop, a clean stubble is most desirable. This is obtained in the improved rotation by preceding the crop with " winter greens," which smothers the weeds, and which, in addition, leaves the land in a fine, friable and much easier tilled condition for the flax crop.

It will be noted also that the improved rotation allows of a more even distribution of labour throughout the year. Also that a good portion of albuminous food is grown in the form of vetches and " winter

greens." It may be added that, in the writer's opinion, where dairy farming is followed, it will be more preferable to substitute a second crop of vetches, which can be cut twice for hay, ensilage, or for winter soiling in place of corn grown in the fourth year of the improved rotation.

CHAPTER XIX

SCIENCE AND PRACTICE OF FEEDING

No farmer, be he large or small, can hope to get the best results from the feeding of his stock if he has not, at least, a working knowledge of the scientific principles involved in foods and feeding. Standard rations may be given, but, like standard manurial formulæ, they can more often than not be improved upon by the man who has a brain, and will use it.

All food can be divided into the digestible and indigestible portion. From the feeder's standpoint, we need only concern ourselves with the former. This digestible portion becomes "dissolved" in the animal's stomach, absorbed into the blood stream, goes to repair the different parts of the body, and supply the animal with heat and energy. (This portion is spoken of as the MAINTENANCE DIETARY OF THE FOOD.)

All the digestible part, over and above that required for maintenance, is utilised for the production of various animal products. This is called the PRODUCTIVE DIETARY, and, in the case of a dairy cow, goes to form milk, and help in the building up of the unborn calf, whilst in bullocks, pigs, and store sheep it goes to produce beef, pork, and mutton, respectively, and also wool in the sheep. In the case of ewes, part of the productive dietary helps in the building up of the unborn lambs, and the milk for the lambs when born.

The fact that a large portion of the food supplied to an animal goes to maintenance, in other words simply serves to keep the animal living, whilst the surplus goes to produce increase of weight, milk, etc., is all important.

MAINTENANCE AND PRODUCTION

For instance, a bullock weighing 10 cwt. wants about 1 st. of meadow hay and 3 st. of swedes per day, practically half a daily ration, as a maintenance diet. It is the food over *and above this quantity which is available for the putting on of flesh.* Therefore, the shorter the fattening period can be made—without, of course, risking over-feeding—the less dead loss there is as regards the maintenance dietary.

In the case of pigs, sheep, and dairy cows, this loss from under-feeding is more pronounced. Hence the folly of a large number of farmers, in Ireland especially, of keeping dairy cows dry all winter—cows which are dairy cows in summer and pensioners in winter.

THE REAL NUTRIENTS OF FOOD

We can further subdivide the digestible portions of food into three parts, known respectively as (1) albuminoids or as this part is sometimes called, proteids or protein, (2) fat or oil, and (3) carbohydrates. Each of these food ingredients has a definite function to perform in the animal body.

Just as a man who sets about building a wall wants

a certain amount of brick or stone, lime and sand, so does a beast, in the building up of its body, or in the manufacture of such products as milk or wool, require each of the particular food ingredients mentioned above for the purpose.

We can carry the analogy still further. The bricklayer or stonemason will require brick or stone, lime and sand in certain proportions. If, for instance, he has sufficient lime and sand for the making of the requisite amount of mortar for 20 rods of a wall, and only sufficient stone or bricks for 10 rods, then the wall-building must cease when the 10 rods is erected, until a further supply of building material is obtained. In like manner a beast must have the proteins, oils, and carbohydrates in certain proportions for its proper nourishment.

Now, if the builder has a sufficient supply of brick or stone, but a deficiency of either sand or lime, he can continue building an inferior type of wall—a dry wall—without the lime. In like manner a beast fed on albuminoids and carbohydrates, but without the third ingredient, oil, can continue living and even increase in weight, because the carbohydrates and fat are interchangeable.

Again, a beast can be fed—but not economically—on albuminoids and fat without carbohydrates. Like the building of the dry wall the results of feeding on two foods, though, are not as good as when the three substances are available.

Without either sand or lime a perfectly dry wall can be erected with brick or stone alone, and in like manner a beast can—again not economically—be fed for a time on pure albuminoids. *This is because the albuminoids can fulfil the functions of both fat and carbohydrates*, but the point to be especially remem-

bered is that NEITHER FAT NOR CARBOHYDRATES CAN BE CONVERTED INTO OR FULFIL THE FUNCTIONS OF ALBUMINOIDS. In other words, no matter how liberally a beast be fed on fat or carbohydrates, the beast, in the absence of albuminoids, will die.

THE ALBUMINOID OR NUTRITIVE RATIO

The fat and carbohydrates in a food are often spoken of as the non-albuminous portion, and the albuminoids or protein as the albuminous.

Realising the necessity for a ration to have the digestible ingredients of a food in certain proportions, scientists have devised what is known as the albuminoid ratio. This means the ratio between the albuminous food and the non-albuminous, when the fat in a food is expressed in its carbohydrate equivalent. To make the term carbohydrate equivalent quite clear it is necessary to point out that 1 lb. of digestible fat is as valuable for nutrition as 2.3 lbs. of carbohydrates, so that the method of determining the albuminoid ratio is to multiply the digestible fat by 2.3, add to it the digestible carbo-hydrates, and divide the sum obtained by the digestible albuminoids.

For instance, in 100 lbs. of milk we have:—

Digestible albuminoids	3·25 lbs.
Digestible fat	3·75 lbs.
Digestible carbohydrates	4·75 lbs.

According to formula—(fat + 2.3 + carbohydrates) albuminoids—the albuminoid ratio.

In figures, the albuminoid ratio

$$= \frac{3{\cdot}75 \times 2{\cdot}3 + 4{\cdot}75}{3{\cdot}25}$$
$$= 13{\cdot}375 \div 3{\cdot}25 = 4{\cdot}11$$

The answer is approximately 4. That is to say, the albuminoid ratio of new milk is as 1 to 4, or, for every 1 lb. of digestible albuminoids in milk, there are 4 lbs. of digestible non-albuminoids.

BALANCED AND UNBALANCED RATIONS

Now, when a ration contains a proper proportion of digestible albuminoids to digestible fats and carbohydrates, it is spoken of as a balanced ration. On the other hand, if there is a deficiency of albuminoids, or what amounts to the same thing, an excess of fats or carbohydrates, the ration is unbalanced.

All this may read very complicated, but, after all, it is only common sense. Potatoes, for instance, when eaten alone, do not contain sufficient albuminoids for a human being, and hence would not keep a man in health, and, apart from this, if fed on nothing else the man would become nauseated. Neither would a man keep in health and live on a purely albuminous dietary like lean meat. The same applies to farm animals.

Rice or Indian meal is comparatively deficient in albuminoids for pig feeding, and whilst a fairly well-grown pig could be fed on these foods the pig would thrive very slowly and probably get rickets. That the pig would thrive on either meals, even though slowly, is due to the fact that it would eat a large amount of the meals in order to get a sufficiency of albuminoids,

which means passing through its body, unused, the excessive amount of carbohydrates and fat.

MEASURING FOOD VALUES

Just as we can express the length of a wall in feet and inches, the quantity of a liquid in pints, the weight of a substance in lbs., etc., the heat of a substance in degrees, so have we a unit to express the true values of a food. This unit is known as the STARCH VALUE. That is to say, scientists found just exactly what the food value of a pound of starch was, and expressed all food values in terms of starch.

For instance, the starch value of linseed cake is 76, which means that 100 lbs. of linseed cake for feeding purposes—assuming it to be used in a properly balanced ration—is equal to 76 lbs. of starch. In like manner the starch value or equivalent of 7 lbs. of meadow hay is 2.59, which means that this quantity of vetch hay has the same feeding value approximately as 2½ lbs. of starch.

The starch value of foods in a manner which need not be here described is calculated from the total amounts of digestible albuminoids, fats, and carbohydrates in a food, and hence enables us at once to see the nutritive value of a food without referring to the amounts of the particular food ingredients which the food contains.

THEORY AND PRACTICE—A SHORT CIRCUIT

A study of the foregoing is useful in order to get a thorough grip of the principles underlying the science

of feeding. In practice there is not the slightest need to worry about the percentage of digestible, oil and carbohydrates, or to calculate albuminoid ratios in the manner described. Neither is there any need, as nearly all text-books state there is, to study the amount of dry matter or digestible fibre in a ration.

All that need be considered by the practical man in making up a ration is the amount of digestible albuminoids and the starch value of a ration. If these two things are correct, there is bound to be a sufficiency of non-albuminous food and dry organic matter in any practical ration, a fact which seems to have been lost sight of by writers of scientific text-books.

Further, by only considering the two factors mentioned, and also by giving the actual weight of digestible albuminoids and the starch value of such quantities of food as are usually used in practice (instead of giving the percentage composition only as the text-books do) we can make a short cut in the calculation of food rations. In short, the whole science of compounding rations can be boiled into such a simple and brief calculation that any man, even a farm labourer, can use the system.

We now give a table, showing the total amounts of digestible food ingredients, and the starch value of different foods. The quantities of food stated are such as are usually used in the daily rations for farm animals. In accordance with what has been said before, there is really no reason for the compounding of foods to include anything more in this table than the figures relating to the digestible albuminoids (proteins is the same thing) and the starch value, but the amounts of digestible oil, fat, and carbohydrates are included in order to admit of useful comparison being made between the different kinds of foods:—

TABLE SHOWING DIGESTIBLE CONSTITUENTS, STARCH VALUE OR EQUIVALENT CONTAINED IN CONTINUOUS CROPS AND OTHER FOODS.

	Food	Quantity stones	Digestible Quantities			
			Oil or Fat lbs.	Carbo-hydrates lbs.	Protein or Albu-minoids lbs.	Starch Value lbs.
DRY FODDER	Oat Straw	½	·035	2·73	·07	1·33
	,, ,,	1	·07	5·46	·14	2·66
	,, ,,	1½	·105	8·19	·21	3·99
	Wheat Straw	½	·035	2·38	·017	·84
	,, ,,	1	·07	4·76	·034	1·68
	,, ,,	1½	·105	7·14	·051	2·52
	Barley Straw	½	·035	2·8	·035	1·33
	,, ,,	1	·07	5·6	·07	2·66
	,, ,,	1½	·105	8·4	·105	3·99
	Meadow Hay	½	·07	2·87	·28	2·17
	,, ,,	1	·14	5·74	·56	4·34
	,, ,,	1½	·21	8·61	·84	6·51
	Clover Hay	½	·1	2·66	·385	2·17
	,, ,,	1	·2	5·32	·77	4·34
	,, ,,	1½	·3	7·98	1·155	6·51
	Mixed Vetch and Cereal Hay	½	·07	2·898	·724	2·59
	,, ,,	1	·14	5·796	1·448	5·18
	,, ,,	1½	·21	8·694	2·172	7·77

	Food	Quantity stones	Digestible Quantities: Oil or Fat lbs.	Carbo-hydrates lbs.	Protein or Albu-minoids lbs.	Starch Value lbs.
ROOTS	Mangels	1	·014	1·26	·014	·98
	,,	2	·028	2·52	·028	1·96
	,,	3	·042	3·78	·042	2·94
	,,	4	·056	5·04	·056	3·92
	Swedes	1	·014	1·12	·035	·98
	,,	2	·028	2·24	·07	1·96
	,,	3	·042	3·36	·105	2·94
	,,	4	·056	4·48	·14	3·92
SILAGE "WINTER GREENS" AND SOILING CROPS	Hardy Green Turnips	1	·035	·7	·07	·84
	,, ,,	2	·07	1·4	·14	1·68
	,, ,,	3	·105	2·1	·21	2·52
	,, ,,	4	·14	2·8	·28	3·36
	Rape	1	·07	·84	·21	1·12
	,,	2	·14	1·68	·42	2·24
	,,	3	·21	2·52	·63	3·36
	,,	4	·28	3·36	·84	4·48
	Kales	1	·07	·98	·21	1·26
	,,	2	·14	1·96	·42	2·52
	,,	3	·21	2·94	·63	3·78
	,,	4	·28	3·92	·84	5·04
	Green Rye	1	·07	2·66	·196	1·58
	,, ,,	2	·14	5·32	·392	3·16
	,, ,,	3	·21	7·98	·586	4·74
	,, ,,	4	·28	10·64	·784	6·32
	Green Vetches	1	·035	·98	·28	1·12
	,, ,,	2	·07	1·96	·56	2·24
	,, ,,	3	·105	2·94	·84	3·36
	,, ,,	4	·14	3·92	1·12	4·48
	Italian Rye Grass	1	·07	1·58	·18	1·69
	,, ,, ,,	2	·14	3·16	·36	3·38
	,, ,, ,,	3	·21	4·74	·54	5·07
	,, ,, ,,	4	·28	6·32	·72	6·76

	Food	Quantity stones	Digestible Quantities: Oil or Fat lbs.	Carbohydrates lbs.	Protein or Albuminoids lbs.	Starch Value lbs.
MEALS AND CAKES	Vetch Silage	1	·1	1·75	·41	1·47
	,, ,,	2	·2	3·5	·82	2·94
	,, ,,	3	·3	5·25	1·23	4·41
	,, ,,	4	·4	7	1·64	5·88
		lbs.				
	Decorticated Cotton Cake	1	·085	·2	·34	·71
	,, ,,	2	·17	·4	·68	1·42
	,, ,,	3	·255	·6	1·02	2·13
	,, ,,	4	·34	·8	1·36	2·84
	Undecorticated Cotton Cake	1	·05	·2	·155	·4
	,, ,,	2	·1	·4	·31	·8
	,, ,,	3	·15	·6	·465	1·2
	,, ,,	4	·2	·8	·62	1·6
	Earth Nut Cake	1	·095	·2	·4	·79
	,, ,, ,,	2	·19	·4	·8	1·58
	,, ,, ,,	3	·285	·6	1·2	2·37
	,, ,, ,,	4	·38	·8	1·6	3·16
	Palm Nut Cake	1	·095	·36	·14	·72
	,, ,, ,,	2	·19	·72	·28	1·44
	,, ,, ,,	3	·285	1·06	·42	2·16
	,, ,, ,,	4	·38	1·44	·56	2·88
	Cocoa Nut Cake	1	·095	·39	·17	·78
	,, ,, ,,	2	·19	·78	·34	1·56
	,, ,, ,,	3	·285	1·17	·51	2·34
	,, ,, ,,	4	·38	1·56	·68	3·12
	Linseed Cake	1	·095	·32	·25	·76
	,, ,,	2	·19	·64	·5	1·52
	,, ,,	3	·285	·96	·75	2·28
	,, ,,	4	·38	1·28	1·	3·04
	Maize or Indian Meal	1	·045	·68	·07	·84
	,, ,,	2	·09	1·36	·14	1·68
	,, ,,	3	·135	2·04	·21	2·52
	,, ,,	4	·18	2·72	·28	3·36

	Food	Quantity Pounds	Digestible Quantities			
			Oil or Fat lbs.	Carbo-hydrates lbs.	Protein or Albu-minoids lbs.	Starch Value lbs.
OFFALS AND GRAINS	Wheat (Grain)	1	·012	·65	·09	·73
	,, ,,	2	·024	1·3	·18	1·46
	,, ,,	3	·036	1·95	·27	2·19
	,, ,,	4	·048	2·6	·36	2·92
	Oats (Grain)	1	·053	·45	·09	·63
	,, ,,	2	·106	·9	·18	1·26
	,, ,,	3	·159	1·35	·27	1·89
	,, ,,	4	·212	1·8	·36	2·52
	Rye (Grain)	1	·01	·65	·09	·72
	,, ,,	2	·02	1·3	·18	1·44
	,, ,,	3	·03	1·95	·27	2·16
	,, ,,	4	·04	2·6	·36	2·88
	Barley (Grain)	1	·017	·64	·07	·74
	,, ,,	2	·034	1·28	·14	1·48
	,, ,,	3	·051	1·92	·21	2·22
	,, ,,	4	·068	2·56	·28	2·96
	Field Beans or Bean Meal	1	·012	·48	·19	·67
		2	·024	·96	·38	1·34
	,, ,,	3	·036	1·44	·57	2·01
	,, ,,	4	·048	1·92	·76	2·68
	Wheat Pollard or Sharps	1	·03	·56	·12	·74
		2	·06	1·12	·24	1·48
	,, ,,	3	·09	1·68	·36	2·22
	,, ,,	4	·12	2·24	·48	2·96
POTATOES AND SUNDRIES	Potatoes	1	·001	·19	·001	·19
	,,	2	·002	·38	·002	·38
	,,	3	·003	·57	·003	·57
	,,	4	·004	·76	·004	·76
	,,	5	·005	·95	·005	·95
	Treacle	1	—	·55	—	·48
	,,	2	—	1·1	—	·96
	,,	3	—	1·65	—	1·44
	,,	4	—	2·2	—	1·92

Food	Quantity	Digestible Quantities			
		Oil or Fat lbs.	Carbo-hydrates lbs.	Protein or Albu-minoids lbs.	Starch Value lbs.
	Gallon				
New Milk . .	¼	·175	·237	·162	·8
,, ,, . .	1	·35	·474	·324	1·6
,, ,, . .	1½	·525	·711	·486	2·4
,, ,, . .	2	·7	·948	·648	3·2
Separated Milk .	¼	·005	·25	·175	·4
,, ,, .	1	·01	·5	·35	·8
,, ,, .	1½	·015	·75	·525	1·2
,, ,, .	2	·02	1·	·7	1·6

FEEDING STANDARDS

In addition to ascertaining the starch values or equivalents of foods, Kellner, a famous German agricultural chemist, conducted a large number of epoch-making experiments, and drew up tables showing the amount of digestible protein required per day, as well as the starch equivalent of the daily ration necessary for the economical feeding of farm animals. These tables may be studied in any modern text-book, as well as in the admirable translation made by Dr. Goodwin, of Kellner's work.*

It may be here stated that whilst the writer has found Kellner's feeding standard very useful in his practical work, he is of the opinion that the amounts of digestible proteins recommended by Kellner seem in several instances to be too low for the requirements of animals in this country.

For instance, for an 11 cwt. cow giving 2 gallons of milk per day, Kellner recommends a ration containing

* Published by Duckworth and Co.

2 lbs. of digestible albuminoids per day, and having a starch equivalent of from 10.75 lbs. to 12 lbs., and for such a cow when yielding 1 gallon of milk per day from 1.1 to 1.4 lbs. of digestible protein, the total daily ration having a starch equivalent of from 8.5 to 9 lbs. Now, when a good dairy cow—one, say, which will yield 4 gallons of milk per day at her flush period—has declined in her milk yield to 1 to 2 gallons, she has reached the stage when, if in calf, an extra strain is thrown upon her.

Fed strictly according to the Kellner standard, she will come to the calving time in a weak and poor condition. The result is that the calf may also be weak, and invariably after calving, a large amount of food which should go to milk production, is used to tone up the cow. In plainer language, the thin dairy cow, after calving, "puts the grub on to her ribs instead of into the pail," or if by nature she is a heavy milker she loses weight during her flush period. Better fed when drying off or when dry, such a cow would improve in her condition and have a reserve, which she could afford to lose during the heavy milking period.

The importance of keeping dairy cows reasonably well fed in the later stages of the milking period, and also when dry, cannot, in the writer's opinion, be over emphasised. Again, in the case of a cow which is not in calf when she has commenced to dry up, it is then generally more profitable to feed her well, so that she is fat for beef when finished milking, rather than keep her, even on a low dietary and a long time dry.

CHEAP PROTEIN

It must, though, be kept in mind that Kellner and

others, who have written on the feeding of farm animals, have always had at the back of their minds the very high cost of albuminous foods, which under the ordinary system means, in practice, the purchased foods. Hence, in compounding rations the general recommendations would be to keep the albuminoids or proteins in a food at the minimum, but in the Continuous Cropping System we grow a large amount of cheap albuminous food, and strict economy in its use is not so essential.

CHAPTER XX

THE WIBBERLEY FEEDING STANDARD FOR MILK PRODUCTION.

As a guide the following table of feeding standards is put forward by the writer. Later experiments conducted by those who have more time for the purpose than I have, may demonstrate that the table and the Continuous Cropping rations recommended are not the most economical. For the time being, the rations may be put forward with confidence, since they are such as the writer uses in practice, and by their use is able *to produce milk, beef, mutton, etc., at about one-half the cost involved where stock are fed on ordinary farm crops*, with the necessary complement of purchased albuminous feeding stuffs to form balanced rations.

It will also be of interest to state that, in arriving at the Continuous Cropping rations, the chief method followed has been that of the comparative principle of ascertaining the digestible protein contents, and the starch equivalents of well-known ordinary rations, and then to compound the Continuous Cropping rations of approximately the same composition:—

TABLE SHOWING DAILY FEEDING STANDARDS RECOMMENDED FOR DAIRY COWS OF ABOUT 10 CWT. LIVE WEIGHT.

Food	Digestible Proteins	Starch Equiv.
	lbs.	lbs.
When dry or yielding 1 gal. of milk per day	1·5	9
Yielding 1½ gals. per day	1·75	10
„ 2 „ „	2.	12
„ 2½ „ „	2·5	13·5
„ 3 „ „	3	15
„ 3½ „ „	3·5	16·5
„ 4 „ „	4	18

It will be noticed that in the table, starting with a 2 gallons per day cow as standard, an additional ½ lb. of digestible protein is allowed and the starch equivalent of the ration is increased by 1½ lbs. daily for every additional ½ gallon of milk yielded.

As an example of the use to which the table given may be put, and to demonstrate the comparative principle previously referred to, on which rations may be compounded, a winter dairy cow, yielding from 2½ to 3 gallons of milk per day, would be considered to be well fed on a daily dietary of 1½ stone of meadow hay, 4 stone of swedes, 3 lbs. of decorticated cotton cake, and 3 lbs. of maize meal. We can set out the digestible protein and starch equivalent of this ration in the following manner:—

RATION No. 1.

	Digestible Protein lbs.	Starch Equiv. lbs.
1½ st. meadow hay . . .	·84	6·51
4 st. swedes	·14	3·92
3 lbs. decorticated cotton cake .	1·02	2·13
3 lbs. maize meal	·21	2·52
Total . .	2·21	15·08

This ration, according to the table, whilst having a correct starch equivalent, even for a 3 gallon cow, is deficient to the extent of approximately ¾ lb. of digestible protein per day for such an animal, whereas the following Continuous Cropping ration has practically the same starch equivalent and contains over 3 lbs. of digestible protein:—

RATION NO. 2.

Food	Digestible Protein lbs.	Starch Value lbs.
1 st of vetch hay	1·44	4·18
1 st meadow hay	·55	4·24
6 st. of rape	1·26	6·72
Total	3·26	15·14

In the case of a cow yielding, say, 4 gallons of milk per day, it would not, as may be supposed, be sufficient to increase the quantities of each of the foods contained in Ration 2, in order to supply additional nourishment. So doing, would make the ration too bulky.

In practice, 2 st. or 28 lbs. of dry fodder is about as much as a cow can consume, especially when 6 st. of green fodder is also being fed. It may also be mentioned that fed on green fodder alone, a cow will consume up to 9 or 10 st. per day.

We may look upon No. 2 as a basal ration, and for a cow yielding over 3 gallons of milk per day (or even 2½ gallons if the cow is in poor condition) we may obtain the higher starch equivalent required, and the extra digestible protein, by feeding concentrated food.

A useful rule to follow would be to allow about 2 lbs. of concentrates for every ½ gallon of milk over the 3 gallons standard, or over 2½ gallons, if the cow is in poor condition.

According to the table a 4 gallon cow would require a daily ration equivalent to 18 lbs. of starch and containing 4 lbs. of digestible protein.

The question arises, what concentrates should be used to bring the basal, or No. 2, ration up to this standard?

The basal ration (No. 3) contains:

	Digestible Protein	Starch Equiv.
	3·26 lbs.	15·14
and 4 lbs. of maize meal in addition gives .	·28	3·36
Totals . .	3·54	18·5

The starch equivalent of the ration is near enough for practical purposes, but the digestible protein is deficient to the extent of about ½ lb. If, however, we substitute 2 lbs. of linseed cake in place of 2 lbs. of the maize meal, we get a ration—Ration 3—with a starch equivalent of 18.3 and containing 3.9 digestible protein which is near enough to the standard.

Another method by which the feeding value and protein contents of the ration could be increased, *without purchasing foreign feeding stuffs*, would be by substituting more vetch or clover hay in place of an equal weight of meadow hay, and using home-grown grain as concentrates. Example:—

RATION No. 4.

Food	Digestible Proteins in lbs.	Starch Equiv. in lbs.
1½ st. of vetch and cereal hay . .	2·17	7·77
½ st. of meadow hay . . .	·28	2·17
6 st. of rape	1·26	6·72
3 lbs. crushed oats . . .	·27	1·89
Total . .	3·98	18·55

To take a further illustration of the "comparative principle," it is recommended in the Board of Agriculture leaflet, No. 79, to feed a 2 gallons per day cow on the following daily ration:—

RATION No. 5.

Food	Digestible Protein in lbs.	Starch Equiv. in lbs.
56 lbs. of swedes	·14	3·92
14 lbs. oat straw	·14	2·66
3 lbs. oats	·27	1·89
2 lbs. bean meal	·38	1·34
3 lbs. decorticated cotton cake	1·02	2·13
Total	1·95	11·94

The above ration is recommended for an arable farm, where straw is abundant. The following Continuous Cropping ration, which also contains straw, would have practically the same starch equivalent (11.88 lbs.), but would be richer in digestible protein, containing as it does 2.42 lbs., and being in addition compounded entirely from home-grown food:—

RATION No. 6.

1 st. oat straw 1 st. vetch and cereal hay 4 st. kale	containing 2·42 lbs. of digestible albuminoids with 11·88 starch equivalent.

WET OR FROSTY WINTER RATIONS

There will be times in winter, during frosty or very wet weather, when it may not be possible to use winter greens, kale, rape, etc., for the feeding of dairy cows. Under such circumstances, as previously stated, we shall have to resort to such succulent food as vetch and cereal silage or mangels. Suitable rations for a 3-gallon cow, containing these ingredients, are as follows:—

RATION No. 7.

2 st. vetch and cereal hay 5 st. mangels	containing 2·96 lbs. of digestible albuminoids, with 15·2 lbs. starch equivalent

A ration containing silage as a succulent food would be:—

RATION No. 8.

1½ st. meadow hay . .	containing 3 lbs. of digestible albuminoids, with 15·4 lbs. of starch equivalent.
½ st. vetch and cereal hay	
3 st. vetch and cereal silage	
3 lbs. ground rye . .	

SPRING RATIONS

In the month of April the green food would usually be in the form of green rye. A suitable daily ration at this period would be:—

6 st. green rye . .	containing 2·98 lbs. digestible protein, with 14·96 Starch equivalent.
1 st. vetch and cereal hay	
2 lbs. bean meal . .	

VALUE OF GREEN FOOD

The bean meal and vetch and cereal hay, being astringent, would counteract the laxative tendency of the green rye. The writer considers the above ration one of the best he has used. Whether there is something in green feeding we do not yet properly understand or not, there is no doubt that such a feeding has a value far above that indicated by its chemical composition. The same remark applies to such green feeding as kale, rape, etc., fed in winter, and green soiling crops, e.g., vetches and rye grass in summer.

If the supply of vetch and cereal hay or dry fodder has become exhausted by springtime, as often does

happen, or if a supply of home-grown beans is not available, or decorticated cotton cake is comparatively cheaper than bean meal, the latter could be sold, and decorticated cotton cake, which is also an astringent, used to replace it. When fed in conjunction with decorticated cotton cake, the rye can be used more liberally, say up to 8 st. per day, or 2 lbs. of ground beans with 2 lbs. of crushed oats.

With this quantity, 4 lbs. of decorticated cotton cake would be necessary to form a suitable ration, without any long fodder.

CHAPTER XXI

HOW PRACTICE SUPPORTS THEORY—A RECORD IN CHEAP MILK PRODUCTION

So much for theory, now for practice. The question immediately arises in the mind of every practical farmer: does the cow agree with the chemist? The answer is a decided "Yes."

In an experiment conducted by the writer in the year 1913-14, two lots of cows were fed, one lot on Ration 1 and the other on Ration 2. The results, tested both by the milk produced and the butter fat contents of the milk, demonstrated that Ration 2 was equally as good as Ration 1.

At the time that the experiment was carried out, the cost of the food for the production of 1 gallon of milk on the root, meal, cake ration, was 4¾d., whilst the cost of producing a gallon on the Continuous Cropping ration was only a little more than half of this, viz., 2½d. per gallon, *the lowest cost on record at which winter milk, so far, has been produced in these countries.*

In the experiment the roots were charged at 10s. per ton, winter greens at 3s. per ton, meal and decorticated cotton cake at cost price, i.e., £6 10s., and £9 per ton, respectively, and meadow hay and vetch hay at £2 per ton. These prices were, of course, pre-war time prices. If we consider the comparative cost of food for milk production at present-day prices, the

advantages of the Continuous Cropping ration are even more striking than before the war.

For instance, if roots are charged at £1 per ton, cotton cake and maize meal at £20 and £19 per ton respectively, and meadow hay at £3 per ton, then the cost of the food for the production of a gallon of milk in the case of a cow fed on Ration 1 and yielding 3 gallons per day is approximately 8½d. per gallon. On the other hand by charging oat and vetch hay at the same rate as meadow hay, £3 per ton instead of at £2, as before the war, giant rape at 3s. 6d. per ton, the cost of food to produce 1 gallon of milk on the Continuous Cropping ration is *still only approximately 3.58d. per gallon.*

THE PRICES CHARGED

The publication of the results of the above experiments caused a tremendous amount of interest in both scientific and practical agricultural circles. The question that was often asked in discussing the experiment had reference to the prices at which the various food stuffs were charged against the cow.

A few explanatory words on this point are necessary. The reason why in the experiment the standard of prices was charged in the case of the ordinary ration or Ration 1, was because the Department of Agriculture for Ireland in a winter dairy experiment which that body conducted, adopted the same standard of prices as given above, in the case of hay, roots, cakes and meals, and the object of the writer's experiment was to make a comparison between the cost of milk production as ascertained in the Department's experiment, and the cost when cattle were fed on a Continuous Cropping ration.

It may be mentioned that Ration 1 is similar to the rations used by the Department. The prices at which vetch hay and winter greens are charged in the experiment, both then and at the present time (this is a very important point), are greater than the cost of production of these crops has been for several years. They are such as to warrant the writer in saying that any farmer, in spite of the higher cost of labour, manure and seeds, can still produce these crops at those prices.

On the other hand, objection might be taken to charging at the present time, roots at £1 per ton, as against 10s. Such objection will not be made by anyone growing roots. The crop requires such a large amount of hard labour, that it is very doubtful whether they can be produced at less than £1 per ton at the present time, whereas in the case of giant rape and similar greens, the cost of hand labour involved in the growing of these crops is almost insignificant, practically all the work being done by horses and machinery.

Leaving out the question of the cost of the production of winter greens or roots, the great point to be remembered is, that winter greens, as distinct from roots, are tilled at a time of the year when the rain helps instead of hinders the tillage operations. Practically all the work is horse and machine work, or, to put the case in a nut-shell, in actual farming practice it is more easily possible to grow 20 acres of winter greens than it is to grow 3 or 4 acres of roots.

Another criticism which has been advanced is that it is unfair to charge food to the cattle at actual cost prices. In other words the food should be charged at cost price, minus the manurial value, but this is an argument which applies in both cases. The value of the manure produced would be just as great, if not

more so, from the feeding of the Continuous Cropping ration than from the ordinary one.

PERPETUAL MOTION—G. B. S.

In fact, there is one point in connection with this very matter of the greatest scientific and practical interest. It is a point which serves to demonstrate what a small amount of attention has been devoted to the question of agricultural economics, or the application of scientific findings to the practice of agriculture.

The cost of the production of giant rape is not more than 3s. 6d. per ton, but the manurial value of a ton of giant rape—according to the admirable table compiled by Professor Crowther, of Leeds University—is 4s. 3d. per ton, that is, assuming that the rape is fed indoors, with the further assumption that half of the nitrogen and a quarter of the phosphoric acid are lost in storing.

If eaten on the land, when there would be no loss of the nature indicated, the manurial value of giant rape is 6s. 3d. per ton. In other words, the cost of the production of giant rape (the same is true of other types of winter green) is less than the manurial value of the crop when consumed.

When this fact was mentioned to Mr. George Bernard Shaw, who has several times inspected the writer's work, he referred to Continuous Cropping as "going one better than perpetual motion."

On the other hand, the manurial value of a ton of roots, assuming that they are consumed indoors, is, in the case of turnips, 2s. 7d., swedes, 3s. 8d., mangels, 3s. 5d. per ton, whilst the manurial value of a ton of meadow hay is 16s. 4d., and of a ton of oat and cereal hay £1 1s. 8d.

The manure resulting from a ton of decorticated cotton cake (we are quoting Professor Crowther's table throughout) is £2 14s. 10d., and that resulting from the consumption of a ton of maize meal is 13s. 2d. Using this data, the value of the manure produced by a cow fed on Ration 1 for the winter half-year (160 days) is £2 10s. 11d., whilst that produced by a cow fed on the Continuous Cropping ration is worth £3 3s. 6d. This is assuming that all the food is fed indoors. In the case of the Continuous Cropping ration, a quantity of the giant rape, even with dairy cows, would often be consumed on the land, and therefore the manurial value of the ration would be higher.

CHAPTER XXII

CHEAP BEEF PRODUCTION

THE comparative principle of first ascertaining the starch value and the digestible protein contents of well-known ordinary ration, and then compounding a Continuous Cropping ration of like composition and value, is equally applicable to all other kinds of stock.

For instance, the ration stated below is recommended in the Board of Agriculture's leaflet, No. 7, for cattle from 6 to 12 months old:—

RATION A.

	Digestible Protein	Starch Value
8 lbs. meadow hay . . .	·32	2·48
2 st. swedes . . .	·07	1·98
2 lbs. oat straw . . .	·02	·38
2 lbs. linseed cake . . .	·5	1·52
2 lbs. oats . . .	·18	1·26
	1·09	7·62

A Continuous Cropping ration consisting of:—

RATION B.

4 st. of hardy greens . } containing 1·05 of digestible protein with 7·7 starch equivalent
1 st. clover hay . }

would be equally useful.

It will be understood that both are average rations. At six months old the weaned calves would be consuming only about two-thirds of each ration, the amount of food increasing as the animal advanced in age.

The actual method followed by the writer in feeding weaned calves is to turn them out wherever possible on a plot of rape, say, from September to the end of November. Whilst on the rape, as a corrective, they receive about 1 lb. per head per day of palm nut or cocoanut cake, or better, 1½ lbs. crushed oats, and have a little clover or vetch hay placed in a rack, which they can eat as they desire.

Later, they are put into a movable shed, in which the dry fodder is fed on a more liberal scale, and the cake or oats increased to 2 lbs. per day. For succulent food, they are allowed on all, except very wet or frosty days, to graze a piece of winter greens an hour or so every day. During unsuitable weather, when out-grazing is not possible, the youngsters receive, in the shed, an allowance of from 2 to 3 st. of roots or 1½ to 2 st. of vetch silage. Fed this way, the calves are very healthy. Hoose, the bane of the calf rearer, need not be feared, since the pest causing this disease is not to be found on the winter green crop.

Further, being hardier than in-fed, "coddled" animals, they are better able to withstand other ailments. The greater advantage of out, as compared with in-feeding, is most marked in the following summer, whilst the way calves thrive when grazing rape pasture, cannot fail to strike the least observant.

In the leaflet mentioned above a standard fattening ration for young cattle from 18 to 24 months, is as follows:—

RATION C.

½ st. meadow hay ½ st. oat straw 4 st. swedes 2 lbs. ground nuts 2 lbs. linseed cake 2 lbs. undecorticated cake	containing 1·48 lbs. digestible protine with a starch value of 11·4 lbs.

An alternative Continuous Cropping ration, *not costing more than half the preceding one*, and necessitating no trough or foreign food, would be:—

RATION D.

2 st. vetch and cereal silage 1 st. oat straw 4 st. kale	containing 1·88 digestible protein with 11·97 starch value

FEEDING MATURE CATTLE

As regards the feeding of more mature cattle a very favourite ration for the early fattening of two-year-old beef amongst Norfolk and Scottish feeders, is:—

RATION E.

	Containing Digestible Protein lbs.	Starch Value lbs.
14 lbs. meadow hay	·56	4·34
4 st. swedes.	·14	3·92
5 lbs. linseed cake	1·25	3·80
4 lbs. maize meal	·28	3·36
Total	2·23	15·42

A Continuous Cropping rotation used by the writer for the feeding of such stock from about October to Christmas, is:—

RATION F.

	Digestible Protein lbs.	Starch Value lbs.
¼ st. meadow hay	·48	3·97
¼ st. vetch and cereal hay	·724	2·59
8 st. rape (or kale)	1·64	8·96
Total	2·644	15·42

The two rations are almost identical in feeding value, as gauged by their respective chemical composition and digestibility, but they are far from being identical in cost. Using the same basis of valuation as was adopted in the case of the winter dairy experiment, the cost of Ration E per lunar month may be set down as follows:—

	£	s.	d.
14 lbs. meadow hay per day = 28 stone per lunar month at £3 per ton	0	10	6
4 st. of swedes per day = 14 cwt. per lunar month at £1 per ton	0	14	0
5 lbs. linseed cake per day = 10 stone per lunar month at £20 per ton . . .	1	5	0
4 lbs. maize meal per day = 8 stone per lunar month at £19 per ton . . .	0	19	0
Total cost of Ration per lunar month .	£3	8	6

With Ration F., the cost would be as follows:—

¾ st. meadow hay per day = 21 st. per lunar month at £3 per ton	0	7	11
¼ st. vetch and cereal hay per day = 14 st. per lunar month at £3 per ton	0	5	3
8 st. of rape or kale per day = 28 cwt. per lunar month at 3s. 6d. per ton . . .	0	4	11
Total cost of Ration per lunar month .	£0	18	1

Now the Norfolk or Scottish feeder would be well satisfied, if in feeding Ration E to his stock, the cattle increased at the rate of 2 lbs. per day, live weight, or ½ cwt. per lunar month. A good class of store beast, weighing, when bought in, about 8 cwt. live weight, would therefore, at the end of three lunar months, with the above increase, weigh 9½ cwt. live weight. Anybody in the cattle business knows that a difference of 5s. per live weight cwt. between the purchase price of a store and the selling price of a finished beast, is considered on the average, a good margin. At the present time good quality stores are costing about 70s.

per live weight cwt., whilst well finished beef is selling at about 75s. per live weight cwt. Using the above data, we can set down the profit and loss obtainable by using Ration E or Ration F.

	£	s.	d.	£	s.	d.
Purchase price of store beast, 8 cwt., at 70s. per live cwt.	28	0	0			
Cost of feeding, 3 lunar months, on Ration E, at £3 8s. 6d. per month	10	5	6			
Value of finished beast after 3 lunar months feeding, 9½ cwt., at 75s. live cwt.				35	12	6
Leaving loss				2	13	0
	£38	5	6	£38	5	6

Feeding on the above ration, there is a dead loss per beast of £2 13s. 0d. On the other hand, feeding Ration F, there will be a gross profit of £4 18s. 3d. per beast, as follows:—

	£	s.	d.	£	s.	d
Purchase price of store beast, 8 cwt. at 70s. per live cwt.	28	0	0			
Cost of feeding, 3 lunar months, on Ration F, at 18s. per month	2	14	3			
Value of finished beast, after 3 lunar months feeding, 9½ cwt., at 75s. live cwt.				35	12	6
Leaving profit of	4	18	3			
	£35	12	6	£35	12	6

As is the case of the winter dairy experiment, referred to in the previous chapter, the price at which the winter greens—rape or kale—is charged against the animal, will, by the general reader, be regarded as very low. This is because so very few farmers realise what enormous crops of this type can be grown, by the adoption of proper methods of cultivation, manuring and seeding.

If merely for the sake of argument we assume the cost of production of winter greens to be 10s. per ton, Ration F is far more economical than Ration E. At the price mentioned the cost of feeding Ration F for twelve weeks would be £4 1s. 6d., leaving a net profit of (the manure produced being set against the cost of attendance) £3 11s. per beast. Similar calculations are possible regarding the comparative cost of beef production, when Continuous Cropping rations, other than the one under discussion, are used, as also may calculations in connection with the production of mutton and pork.

AGRICULTURAL AND NATIONAL ECONOMY

Space does not permit of the giving of further instances of the application of the comparative principle of blending Continuous Cropping rations. With the examples already supplied, and with the assistance of the tables given, no difficulty will be experienced in compounding other rations for any other class of stock.

One feature deserving special attention in connection with the Continuous Cropping rations is that, unlike ordinary rations, very little—in several instances none at all—foreign feeding stuffs is used. This is of importance, not only from an agricultural, but from a financial and national standpoint. The economic war will really commence one day in these countries when peace is declared, and the generation whose chief concern will be the patching-up of the Nation's wounds, will give the matter of the importation of foreign food and the exportation of British capital far more attention than it has received in the past. At present we annually import £350,000,000 worth of foreign food for the feeding of ourselves and our flocks

and herds. This is a sum of money which might be kept in the country, did a more productive system of agriculture prevail.

PREPARATION OF FOOD

Just as the case with ordinary foods, there is considerable ingenuity in the actual preparation of animal food.

In the case of dry fodder, vetch hay, etc., particularly the latter, a certain amount, at least, should be chaffed and mixed with a certain amount of chaffed winter silage greens, or pulped roots, and allowed to ferment together before feeding.

Treacle is also a great appetiser, and, when procurable at a cheap rate, should certainly be included in a dairy cow's ration. From 1 to 2 lbs. per day can be given, dissolved in the warm water and poured over chaffed vetch hay, etc.

This making of the food appetising is well worth while in the case of dairy cows and very young stock. In the case of older cattle, except in the later stage of fattening, the writer simply "gives the food as it grows." The winter greens being eaten where grown, roots thrown out unpulped on grass land, and the dry fodder fed in movable sheds. It must be remembered though, that practically all the dry stock are fed this way and fed outside, the open air acting as a good appetiser and the chief economy is in the labour saved in avoiding crop and manure carting, as well as the less labour involved in feeding cattle outside, as compared with stall feeding.

CHAPTER XXIII

CONSUMING THE CROPS—MORE FACTORY METHODS

THE labour economies of Continuous Cropping, or Farming on Factory Lines, is not confined to the growing of the crop, but may also be applied to a considerable extent to the consuming of the crops.

With the exception of crops intended for direct human consumption, e.g., potatoes, cereals, a farmer should look upon the product of his soil as so much raw material to be converted into such marketable commodities as milk, beef, mutton and pork, just as the linen or cotton manufacturers regard flax, or raw cotton as the raw material of their respective industries. The latter type of manufacturer has been and still is on the look-out for more economical methods of production, but the manufacturer of beef, milk, etc., in the majority of cases, has seldom given the economical methods of production, or in the case under discussion, the economical consumption of crops, the slightest consideration.

There are tremendous possibilities in the latter direction, the carting home of, say, a 30 ton crop of winter greens and the carting back and spreading of the necessary farmyard manure to maintain the fertility of the land, may involve a labour expenditure of from 30s. to 40s. per acre. So that by consuming the crops on the land, a saving often greater than the rent, rates and taxes of the acre of land can be effected.

of the " winter greens " is consumed by the cattle on the land. By this means the carting of crop and manure and the spreading of the latter—except such spreading as can be done with a chain harrow—are dispensed with.

Many farmers think that eating the crops off the land cannot be done in winter without excessive poaching. Poaching, of course, would result, if the cattle were allowed out all day, but they are only out for a few hours, just to fill themselves with the winter greens, unless in fairly dry periods when they can go out or in at their leisure. On a very wet day they are not allowed out at all, but get an extra supply of silage in lieu of the green fodder.

If the silage becomes exhausted before the winter season ends, then we cut some of the winter greens and carry them on a very light hay bogey, fitted with wheels 3 ft. high and 6 in. wide. The cutting is done with a mowing machine, with a sheafing attachment, which saves a lot of labour in gathering.

In winter time these green crops do not wilt, and a two or three day's supply can be cut at one time.

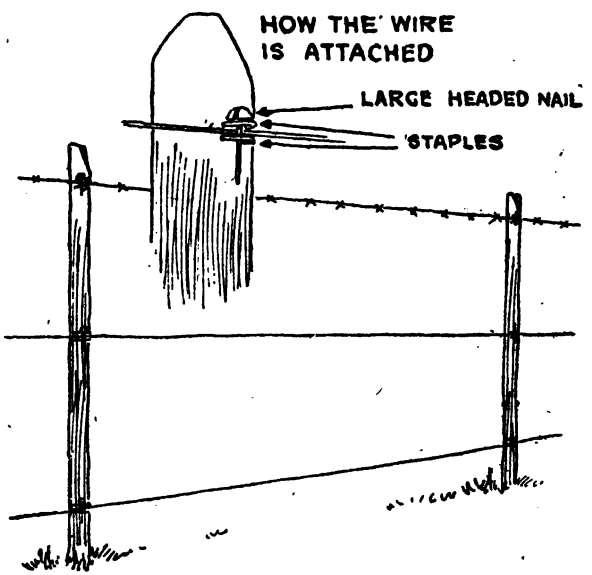
Although a certain amount of poaching does take place on land containing the large amount of vegetable matter, the result where the Continuous Cropping system is followed, is not naturally such a serious thing as it is on land devoid of this substance.

Winter dairy cows (which are usually too much coddled) are also allowed out, except in very bitter weather, for an hour or two to graze the winter greens, or to consume some on a convenient pasture to which the greens are carted.

THE MOVABLE FENCE

The cattle are not allowed to wander over the whole field of winter greens. It is grazed in sections by the assistance of a movable fence. This movable fence is quite a feature in itself.

It simply consists of three strands of wire, the top one barbed, and the two lower ones plain. A post is put down about every six yards, and to these posts the wire is fastened.



THE MOVABLE FENCE.

A big feature of the Wibberley system, enabling summer and winter soiling crops to be fed where grown.

The wire is not stapled to the posts. If it were, there would generally be more trouble in pulling out the staples and shifting the fence than there would be in carting the crop.

One small staple is put above the wire and one below it. The wire is placed between the two, and then a slate nail with a big head is dropped behind the wire. In moving the fence the nail can be picked out with the fingers.

All the other apparatus required is a barrow for a man to stand in and a mallet to drive in the posts.

In grazing the crop down in early winter it should not be grazed bare, but a sufficient length of stalk should be left to make a second growth in spring. This second growth can be grazed off, first by ewes and lambs, and then by hoggets.

We have a lot to learn about the folding system, but one rule is: Never compel fattening cattle, dairy cows, or ewes with lambs to graze down bare. This should be left for store cattle or sheep to do.

INDEX

	Page.
Agricultural Life—	
Drawbacks of ...	46
Meagreness of ...	46
Agricultural Man-Power in Ireland	43
Agricultural position at the present time	38
Agricultural Science needs Practical Knowledge ...	16
Agriculture as an Industry for Mental Activity ...	19
Animals, Feeding Requisites for ...	221, 222
Annual Rainfall—Chart of Average	55
August Rainfall Chart ...	58
Beef Production, Cheap rations for	244
Bullocks, Fluctuating prices for, and cheapest period for	26
Calves, Feeding weaned ...	246
Cattle—	
Continuous Cropping ration for, Cost of ...	248
Fattening, Continuous Cropping ration for young	247
Fattening, standard ration for young ...	246
Movable sheds for ...	253
Rations	244
Rations for mature ...	247
Cereals exhaust soil nitrogen, tares replenish it	105
Chaff ensiling plant, A ...	157
Co. Limerick's gratitude to Mr. Wibberley for introducing his system ...	21
Conquering the climate by altering the tillage system	64
Continuous Cropping—	
Agricultural and National economy of ...	250
Commercial Test applied to	20
Factors in determining rotations	188
Intensive system of farming	51
Inter-cropping of continuous crops ...	175
Labour economies in consuming the crops	252
Less risky than usual rotation	74
Milk output can be increased by ...	191
Mixed vetches and cereals follow lea corn ...	95
Motor implements can be kept at profitable work 80 per cent. of the year	101
Provides cheap albuminous food	232
Requires liberal use of artificial manures to start	30
Roots not included in ordinary rotation ...	173
Spread over wide area of farming	20
Taken up warmly in Germany	52
Two crops of tares and a crop of seeds hay ...	106
Weeding scarcely necessary in	73

Page.

Corn—
- As an Annual which can be made biennial ... 78
- Be early with the sowing and harvesting of ... 94
- Birds' ravages on, and how to combat ... 90
- Demand for as great a supply as possible ... 192
- Disc-drills for sowing ... 177
- Extending the harvest by method of grazing the crops 89
- Inter-cropping with winter greens 178
- Knowledge that has to be acquired for growing 76
- Manures to apply to land for 85
- Manurial dressing effect on the 84
- Modified method of wide drilling, A 184-5
- Necessary conditions for Summer and Autumn sowing of 80
- Safer and more progressive means of raising and harvesting crops needed 78
- Second growth, Advantages of 79
- Should be followed by Tares 98
- Sowing at various periods, and harvesting over six to eight weeks 79
- Subsequent treatment of Summer and Autumn sown crops 88
- Summer-grown, Grazing down a second time ... 177
- Summer-grown, Treatment for 177
- Summer-sown requires a hardy variety ... 85
- Tare-mixture as an inter-crop for 178
- Theory as to why it requires artificial manuring 84
- Versus Fodder production 192
- Wider rows of grain better filled 184
- "Winter-proud" ... 92

Crops—
- Corn crop and forage crop from one seeding, Obtaining 107
- Forage crops allow liberal manuring ... 112
- Making hay if weather is good and ensilage when it is not ... 114
- Manurial values of ... 243
- That cannot be handled by machinery ... 97

Dairy Cows—
- Basal ration for ... 236
- Importance of keeping well fed 231
- Milk producing rations for ... 233-238
- Ration experiments and their results 240-241
- Ration without foreign feeding stuffs ... 236
- Treacle a great appetiser for 251
- Value of green food for 238
- Wibberley feeding standard for in winter ... 235

Dairy farmers' high milk prices, Cause of ... 190

Decadent agriculture the result of past policy ... 18

Dry Farming—
- But little understood ... 140
- Methods ... 137-138

Dry weather effect on sectional sowing 139

Eastern counties climate favourable for ripening and harvesting corn ... 63

England and Wales, Agricultural man-power in ... 44

	Page.
Farm Labourers—	
Better wages must solve the difficulty ...	49
Farm labour demands skill	39
Slackness of, compared with earlier days ...	57
Farm v. Factory—Exodus of labour from the country	46
Farms—	
Grazing versus tillage, the old plan ...	22
Main source of revenue the sale of live stock	25
More acreage tilled in small than in large ...	42
Provided with motor appliances saves labour	187
Wibberley's suggestion with regard to root-growing on ...	168
Farmers—	
Can " carry on " if there is an even distribution of labour throughout the year	90
Characteristics of those changing their methods	18
Critical faculty in, develops progressive methods	67
Expenditure of, on cakes and meals for dairy cows	189
Hints on how to treat your labourers ...	24
More stock-keeping carried on by	188
Must study science and practice of feeding ...	219
Objection of, to inter-cropping corn ...	183
Practical men largely opposed to scientific knowledge ...	16
Prejudiced against scientific methods owing to unpractical enthusiasts	19
Small farmers advised to substitute fodder crops for pasture feeding ...	130
Farming—	
Adverse weather conditions in	47
Horses necessary for the final refining cultivation of the soil ...	102
Ineffective working days under present tillage system	49
Larger proportion of skilled labour needed, than in manufacturing industries	41
Machinery must be more employed in ...	49
Mechanical skill required in	40
On pastoral lines must be done away ...	48
Risk of, not entirely eliminated by Continuous Cropping ...	19
Run on factory methods	48
Stockmen must be skilled	40
Unskilled labour little use in	40
Tillage system more risky than pasture ...	48
Fence, Measurements and plans for movable ...	256
Field cultivated in very dry weather, A	141
Fodder and forage crops under the Continuous Cropping	77
Fodder crops turned into ensilage	158
Folding System, The, Lots still to learn about ...	257
Food—	
Balanced and unbalanced rations	223
Maintenance and productive dietaries ...	220
Measuring values of ...	224
Points to be considered in rations	225

Page.

Preparation of, important for live stock ... 251
Real nutrients of ... 220
Starch value of ... 224
Table showing digestible constituents in 226-230
Food-growing statistics of Great Britain and Germany 52
Foreign cakes and meals used too much ... 190

German agricultural methods beat ours ... 51
Giant Essex Rye—
Sowing 146
Strong points of ... 145
Giant Rape, Sowing and requirements of 148-150
Grass crop is never destroyed by weather ... 192
Grass Dairy-Farming methods 188
Green fodder crops of 30 tons per acre 108
Green manuring ... 210
Guaranteed prices for crops only when garnered ... 51

Hardy green turnips need moisture 150
Hay Making—
Hay-bogie's part in ... 119
Hay loaders or sweeps? 120
If weather is bad, convert hay into ensilage 124
Mistakes in 115
Pikes used largely in Ireland and Scotland in 118
Salt used in the stacking 123
Stacking hay ... 121-124
Start early with ... 110
Up-to-date implements for 116
Wibberley hay-sowing method, The ... 117

Implements—
Agricultural motor, The 98
Chain pump, A ... 113

Page.

Concrete tank for liquid manure 113
Digging plough, The ... 182
Disc harrow, The ... 98
Double and triple-furrow plough, The ... 99
Hay-bogie, A 119
Hay sweep, The ... 121
Light harrow, The ... 101
Motor 101
Side-delivery rake, The 116
Spring tooth harrow, The 183
Swathe-turner, The ... 116
Triple cultivation, The ... 98
Intercropping—
Double row system of ... 180
Land must be liberally manured for ... 181
Limited only by labour pressure 186
Main object of ... 185
Methods, Results of ... 73
"Nurse" crops 175-176
Irish Farm—
Continuous cropping eliminates need for foreign cakes and meals 28
Cost of feeding stuffs purchased the third year 30
Cost of manures and seeds during the three years 31
Irish Farm under Mr. Wibberley—
Experiment began in November, 1913 ... 28
Farm accounts given ... 33-37
Feeding stuffs purchased in first two years ... 29
Harvesting rush and risk owing to climatic conditions 61
Proofs of financial success on the Model ... 27
Rent charged on Model 26
Valuation prices for live stock varies ... 32

Page.

Wage sheet for the three years on 27
Working of the Model 24-37
Irish Farms, Winter 1916-17, Severity of, on ... 153
Irish Farmers' better results from farming live stock than corn ... 77
Irish farming output can be greatly increased ... 44
Irish Labour—
Efficiency of, given a proper chance and wage 23
Value of, when treated properly 24

July Rainfall Chart ... 58

Kale, Varieties of ... 146
Kellner's standard of feeding for animals ... 230

Land—
After potato crop, seldom requires ploughing ... 102
Cold and exposed, sow rye in place of winter oats on 104
Dual management of, bad 23
Reduction of fertility very small in grazed ... 22
Lea Land—
Ploughing flat with a motor plough ... 183
Tillage of, for lea oat crop 181
Tillage of, for potatoes 206
Wibberley system of tillage for 182
Liquid v. Farmyard manure 113
Live-Stock—
Cost of store bullock per live cwt., and selling price of ditto ... 25
Fodder crops will feed a larger number than pasture 130
Profit margin small on selling 25

Page.

Machinery v. Hand Labour on farms 45
Man in the street demands cheap food 51
Man-power for agriculture in Ireland 43
Manure, Liquid, and its value 112
Mangels—
After cultivation of ... 173
Artificial manures for ... 172
Cultivating the land for 168
Planting 170
Preferable to turnips ... 168
Transplanting 170-171
Marrow stem kale, sow for dairy cattle 147
Milk production, Cost of, under Rations 1 and 2, and under Continuous Cropping system ... 241
More home-grown food essential for our country 48
Movable fences on "winter greens" land 254-256
Movable sheds for cattle in forage fields 253

Norfolk System of Tillage—
Climatic influences on the 60
Explanation of ... 54-57
Four-years' Rotation, A 65
Started in Eastern counties, Rainfall influence on 60
Northern Districts September sowings on a large scale are impracticable 109

Oats, August sown, very successful 86

Plants, Little Botany lesson on 166
Ploughs, double and triple-furrow, work done by ... 99
Plunkett, Sir Horace—
On Co-operative imple-

Page.

ment and Continuous Cropping system ... 191
Political nostrums for farmers 50
Potatoes—
Flourish after a winter green crop 168
Tilling lea land for ... 206
Prince Kropotkin, Inspiration for "Continuous Cropping" received from 15
Psychology and its connection with Continuous Cropping 17

Rainfall—
Charts 55-58
In Ireland 61
Statistics ... 193-194
Ration costs compared 233-250
Research work to be done about ensilage ... 158
Root Crops—
After corn—in place of the fallow ... 56
After tares and winter greens 165
Grown on the Continuous Cropping System 165
Require much hand labour 136
When they pay ... 136
Rotations—
Animal husbandry and corn 210
Based on rainfalls ... 195
Cheap labour ... 198
Dry stock farm ... 197
For cattle and sheep farm ... 197-198
For hilly land, which largely dispense with carting or harvesting 203-204
For producing animal and human food ... 206
Large corn-raising with risk reduced ... 209
Mountain farm ... 202
Rye crop grazed by cattle and sheep in May, can

Page.

be followed by winter greens 208
Suited to low rainfalls 212-214
Suited to wet weather ... 208
Summer rye preceding winter greens ... 205
Tillage dairy farm ... 196
Ulster ... 215-217
Rye—Best cereal for early sowing 86
Rye and rape crop mixed 152

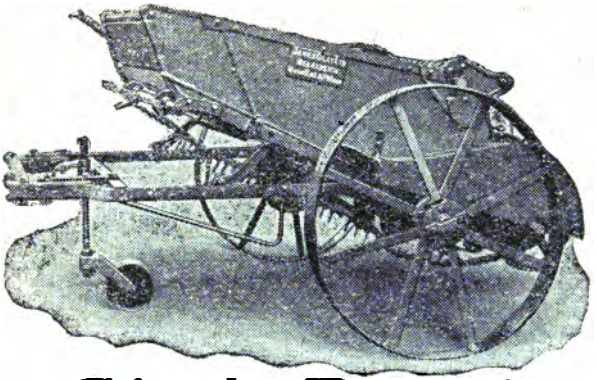
Sectional grazing, Meaning of 131
Sheds, Measurements and plan of movable cattle ... 253
Sheep—
Fed on the land for the first three winters ... 72
Folded in grazing sections of 5 acres to every 200 head ... 152
Small holdings and farms in Ireland, Statistics of 42
Soil—
Conserving moisture in the 140
Cultivation of dry ... 100
Physics of the ... 142
Spring Rainfall Illustrated Chart 55
Stack of Ensilage—
Weighting one ... 126
Stacks, Taking the temperature of 129
Stock-carrying capacity of [illegible]y country, Increasing 204
Stock feeding provided by Continuous Cropping 72-215
Subsidized experiments in winter silage making needed 157
Summer Soiling—
Arranging crops for ... 131
Dividing the land for stock feeding ... 134
Labour economies in ... 133
Meaning of 130

	Page.
Sectional grazing to insure a succession of vetches	131
Sunshine charts ...	62
Sweet Stack Ensilage—	
Making and stacking	125-128
Method in very wet weather	128
Tares—	
Add beans to, for making ensilage ...	104
Applying liquid manure to	114
Autumn-sown—	
Farmyard manuring for	110
Should be cut mid-June ...	93-106
Can be cut twice and thrice in a year by improved methods ...	96
Can be sown at any time	97
Complete manuring mixture for	111
Crop of, can be "darned"	109
Cultivating the land for	98
Cutting, to obtain a second or third crop ...	133
Harvesting	114
High feeding value of ...	95
Right quantity of seed to sow	103
Sowing after potatoes and roots	102
Sown for soiling ...	104
Sown with grass seed mixture	[illegible]
Spring sowing, Artificial manures for	110-111
Summer sowing ...	110
Tares and Sainfoin absorb nitrogen from the air ...	73
Thousand Headed and Curly Kale. Sow from March onwards ...	148
Tillage acreage, Serious decrease in Great Britain of	66
Tillage Dairy-Farm Method, The	189
Tillage dairy farming strongly recommended ...	192
Tillage must be quick in low rainfall districts ...	100
Tillage Systems, Suggestions for	71
Vetch hayseed mixture, A	104
Vetches, Continuous supply of, in Summer and Autumn for soiling ...	130
Welsh climatic conditions	68
Welsh tillage, Rotatory system	67-70
Wibberley, Feeding standard for milk production in	233-238
Winter Cereals—	
Sow early, manure, and let sheep "nibble over" in early winter	93
Sown in southern districts	92
Winter green Ensilage-making	156
Winter Greens—	
Acre drying crops ...	200
As substitutes for roots	135
Cheap tillage for ...	160
Five principal points about	135
Giant Essex Rye ...	144
Giant Rape	146
Kale crops	146
Manuring ...	160-162
Marrow Stem Kale ...	147
Mixed crops of ...	151
Proper manuring for ...	154
Rape and Kale pasture	153
Seeds to use per acre ...	163
Sowing by drills ...	164
Thousand Headed and Curly Kale	148
Winter pasture in mountainous districts very useful	152

Cahill & Co., Ltd., Printers, London and Dublin.

YB 51348

"CLAYSELL"



Clay's Patent Manure Distributor

WILL DISINTEGRATE

- And distribute any variety of Farmyard Manure broadcast or in Furrows.
- Can also be employed for soils and equivalent.
- It will not bind or clog with the longest or heaviest Straw Manure.
- Simple and free from Complications, and is left clean after each operation.
- It can be used as an INDEPENDENT CART or (with shafts removed) easily and readily attached to the ordinary Dung Cart.

The *Mark Lane Express Agricultural Journal* says:
"The machine does excellent work. The manure is thoroughly broken up and spread more evenly than is possible by hand work."

Numbers are already order[illegible]d if [illegible]are requiring one of these Valuable Implements this season y[illegible]ould order immediately.

ecretaries and Managers of Agricultural Co-Operative Societies should write for Price and full Particulars to the sole Agents:—

MILLER, GIBB (LONDON) & CO.,

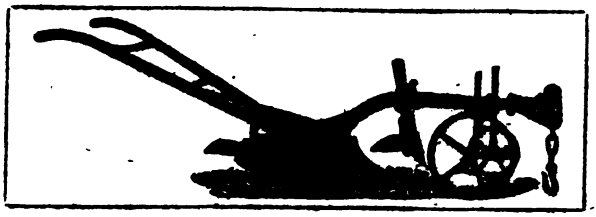
83, FINSBURY PAVEMENT, LONDON, E.C. 2.

Telegrams—"MILGIBCO, LONDON."

SELLARS' MOVABLE POINT

PLOUGHS

WON THOUSANDS OF PRIZES.



Suitable for All Kinds of Soils. THOUSANDS IN USE.

G. SELLAR & SON, HUNTLY.

A STANDARD WORK BY AN EXPERT AUTHORITY.

Dairy Farming for Smallholders.

By James Long, formerly Professor of Dairy Farming, Royal Agricultural College; Author of "The Book of the Pig," etc. Crown 8vo, cloth. Price 2/6 [illegible] post free 2/10.

THE CHAPTERS DEAL WITH:—Our Dairy Cows; The Cow and Her Management; Foods and Feeding; Milk; Butter and Butter Making; Cheese Making, etc.

"This is one of the best handbooks that can possibly find its way on to the dairy farmer's shelf."—*The Dairy.*

C. ARTHUR PEARSON, Ltd.,
HENRIETTA ST., LONDON, W.C. 2.

WILL FARMERS PLEASE NOTE?

Mr. Wibberley's method is to work according to the formula. "The rain that stops the reaper starts the plough." You can learn all about it in two other books by the Continuous Cropping Champion that have

SOLD BY THOUSANDS.

Continuous Cropping and Tillage Dairy Farming for Small Farmers.

By T. WIBBERLEY, N.D.A., N.D.D.

Here Mr. Wibberley describes specially for the benefit of the small man a revolutionary system of all-weather farming capable of doubling or trebling the profits of even the best regulated small dairy farms. In this book he discloses for the first time the whole secret of his success, and the success of the many thousands of small dairy farmers who follow him.

Its Price is 2s. 6d. net, or post free 2s. 9d. from
Messrs. C. ARTHUR PEARSON, Ltd., 18 Henrietta St., London, W.C. 2

Another excellent handy little work by Mr. Wibberley, which can also be obtained of Messrs. C. Arthur Pearson, Ltd., post free 7d., is

WAR TIME FARMING

Price **6d.** net.

This, in a few graphic but deeply instructive pages, supplies a complete practical solution to the problem of increasing production, in spite of our unprecedented labour shortage, prohibitive food prices, and other abnormal conditions we have now got to face.

"Remember Mr. Wibberley has been specially lent to the Board of Agriculture by Queen's University, Belfast, to lecture in this country on his Continuous Cropping System, at the personal request of Mr. Prothero to his University Senate. Why? Because Mr. Wibberley is not only an agricultural scientist, writer and lecturer, but is above all a practical farmer, who ten years before the war was thought of, recognised what our agricultural mandarins don't seem to have recognised yet. That is—that the main cause of the tillage decline in this country—the reason why the British farmer in the ten year period, 1903-13, allowed a million acres of plough land to fall into grass—was because of unsuitable weather conditions for the carrying on of farming operations on the old lines of the Norfolk rotation."—

THE SMALLHOLDER.

That is why Continuous Cropping is advancing in this country now by leaps and bounds, and why all farmers should learn its secrets to-day.

The "Smallholder" Library

In Stiff Paper Boards. Price 1s. net. Post free 1s. 3d. each.

A Series of Handbooks specially prepared for the use of Smallholders and all who work on the land.

No. 1. **Profitable Bee-Keeping.** By H. E. Geary, F.E.S., Expert to the Leicestershire Bee-keepers' Association, etc. With 13 Illustrations from Photographs.

"This is a model of what such a handbook ought to be...."—*Morning Post.*

No. 2. **Practical Hints for the Holding.** With 240 Illustrations. A Series of Prize Paragraphs from "The Smallholder," giving practical advice on the working of a Small Holding.

"The contents of this book are gathered from numerous sources, and the editor has done his work well . . . a very serviceable guide."—*Field.*

No. 3. **Profitable Poultry-keeping.** For Small Holders and others. By the Poultry Experts of "The Smallholder." With 18 Photographs and many Diagrams.

"A practical manual."—*Pall Mall Gazette.*

No. 4. **The Market Garden: How to Start and Run it Profitably.** With numerous Illustrations. By the Gardening Experts of "The Smallholder."

"Contains sound and practical advice."—*Farm and Home.*

No. 5. **French Gardening.** A Manual of Intensive Culture. By Thomas Smith, F.R.H.S. With 22 Full-page Illustrations and a Plan. This volume may also be had in Cloth Boards. Price 2s. net; post free 2s. 4d.

No. 6. **Pigs: How to Make them Pay.** Breeding, Feeding and Housing. With numerous Illustrations and Photographs.

"The book is an excellent shilling's worth, and one that may be confidently recommended to the Pig-keeper, whether Smallholder, Farmer or Cottager."—*Bazaar.*

No. 7. **Pigeons for Profit.** The whole Art of Squab Raising, with chapters on Racing and Fancy Pigeons. By Percival Bretton. Illustrated by 9 Photographs and other Illustrations.

"The main object of the book is to show how to make pigeon-keeping a profitable business."—*Morning Post.*

No. 8. **Manures and Manuring.** By "Farmer Giles." New and revised Edition. This volume explains in plain language the right methods of treating all kinds of Crops.

No. 9. **Utility Rabbit Keeping.** With chapters on Fancy Rabbits, Rabbits for Exhibition, etc.

"Will be of great assistance to Rabbit-keepers."—*Farm and Home.*
"All interested in our food supply should secure a copy at once."—*Fur and Feather.*

No. 10. **The Allotment Book.** How to make the most of your land. By Walter Brett. Author of "War-time Gardening."

A. F. SOWTER, Publisher, "Smallholder" Offices, 16-18 Henrietta Street, London, W.C. 2.

No. 11. **The Potato Book.** All about the Potato. By. J. C. NEWSHAM, F.L.S. With Eight Pages of Photographs and other Diagrams.

No. 12. **Profitable Goat Keeping.** By the Experts of "The Smallholder." With numerous Illustrations. Stiff boards. Price 1s. net.

SOME USEFUL HANDBOOKS

The Hobby Gardener. By A. C. MARSHALL, F.R.H.S. With 22 full-page Illustrations showing clearly the various operations throughout a year's work in the garden. In Stiff Three-coloured Cover. Price 1s. net, post free 1s. 3d.

Small Gardens and How to make the Most of Them. By V. P. BIDDLE. Cloth Boards. Price 1s., post free 1s. 3d.

A most useful Handbook for the Amateur. Full instructions are given for laying out, bedding, arrangement of borders, vegetable culture, flowers and fruit trees, room plants, window boxes, etc.

Greenhouses: How to Make and Manage them. By WILLIAM F. ROWLES. With numerous Diagrams. Cloth. Price 1s., post free 1s. 3d.

Some of the 22 Chapters deal with:—House Construction—The Heating Question—Working up Stock—Propagation—Pots and Potting—Soils and Manures—Watering—Shading—Tying and Staking—Syringing—Training—Pinching and Pruning—Arranging—Forcing—Critical Periods in Plant Life—Specialisation, etc., etc.

The Dog: In Health and Disease. By F. M. ARCHER. With 12 Illustrations by S. T. DADD. Cloth. Price 1s., post free 1s. 3d.

Cage and Singing Birds. By GEORGE GARDNER. With numerous Illustrations. Cloth. Price 1s., post free 1s. 3d.

Some of the Contents are:—Birds for Song, for Exhibition and for Breeding—Care of Young—Seeds:—how and what to buy—Moulting for Song and for Exhibition—Colour feeding: how it is done—Diseases of Cage Birds and how to treat them—Bird Fever—Parasites and how to destroy them etc., etc.

Poultry Keeping, and How to Make it Pay. By F. E. WILSON. Cloth Boards. Price 1s. net, post free 1s. 3d.

The information given includes:—Natural and Artificial Hatching—The Rearing and Management of Chickens—Housing, Feeding, and Exhibiting Poultry—Breeding for Egg Production—Ducks for Profit, etc., etc.

An Easy Poultry Guide. By EDWARD BROWN, F.L.S. With Eight full-page Illustrations and other diagrams. Pocket size. Cloth. Price 1s. net, post free 1s. 2d.

The Smallholder's Year Book.

Published annually in December. Price 1s. net; post free 1s. 4d.

The Smallholder's Year Book is now an institution. It is the recognised court of appeal in all matters connected with the land in gardening, farming, poultry-keeping, goat, rabbit and bee-keeping circles. It contains the cream of all the information that has ever appeared in THE SMALLHOLDER. It solves at a glance every problem that is ever likely to puzzle YOU.

The Books may be ordered through any Bookseller, or will be sent on receipt of the price quoted from A. F. SOWTER, Publisher, "Smallholder" Offices, 16-18 HENRIETTA STREET, LONDON, W.C. 2.

LIME

HYDRATE OF LIME

sold under the trade name

LIMBUX

is

PURE LIME FLOUR.

LIMBUX is excellent for dry spraying.

LIMBUX is excellent for dusting soil at planting and sowing time.

LIMBUX gives to the GARDEN what health and youth give to life.

LIMBUX ensures HEALTHY conditions, vigorous growth and plant stamina.

LIMBUX is the most USEFUL form of Lime for smaller gardening operations, and can only be supplied by

THE

BUXTON LIME FIRMS CO., Ltd.

Head Office :

ROYAL EXCHANGE, BUXTON.

Telephone 312 Buxton.

Telegrams "Buxton Lime, Buxton."

LIME FOR ORCHARD WORK:

a special department under supervision of experts.

LIME

The value of Lime in Agriculture and Horticulture is so generally accepted, that no special pleading is necessary.

It is the form in which Lime is used and its method of application that are things that matter.

First of all, the highest LIME VALUE for money is a consideration.

Where the purest Lime known in commerce is the starting point, a good start is made.

Next in importance is the most suitable form in which Lime is applied to give the BEST RESULTS and the BEST VALUE for money.

The PUREST LIME known in commerce is

OLD BUXTON LIME

AND THAT CAN ONLY BE SUPPLIED BY

THE BUXTON LIME FIRMS CO., LTD.,

Head Office: ROYAL EXCHANGE, BUXTON.
Telephone: 312 Buxton. Telegrams: "Buxton Lime, Buxton."

London Office: 11, QUEEN VICTORIA STREET.
Telephone: 1504 Central. Telegrams: "Buxtolim, London."

Manchester Office : : : : 79, PICCADILLY
Telephone: 2982 Central. Telegrams: "Buxton Lime, Manchester."

Liverpool Office : : : 162, CROWN STREET
Telephone: 919 Royal.
Telegrams: "Buxton Lime, 162 Crown Street, Liverpool."

BRANCH AGENCIES EVERYWHERE.

[redacted] as good."

Every [redacted] ant attention.